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WORLD PETROLEUM

Pulling Down the Pillars of Business—The Most Recent Administration Attack on American Business • War Factor in German Oil Policy • America's Place in International Oil Trade • Discovering Oil from 20,000 Feet • Vast Fleets of Trucks Serve Oil Industry

APRIL • 1936

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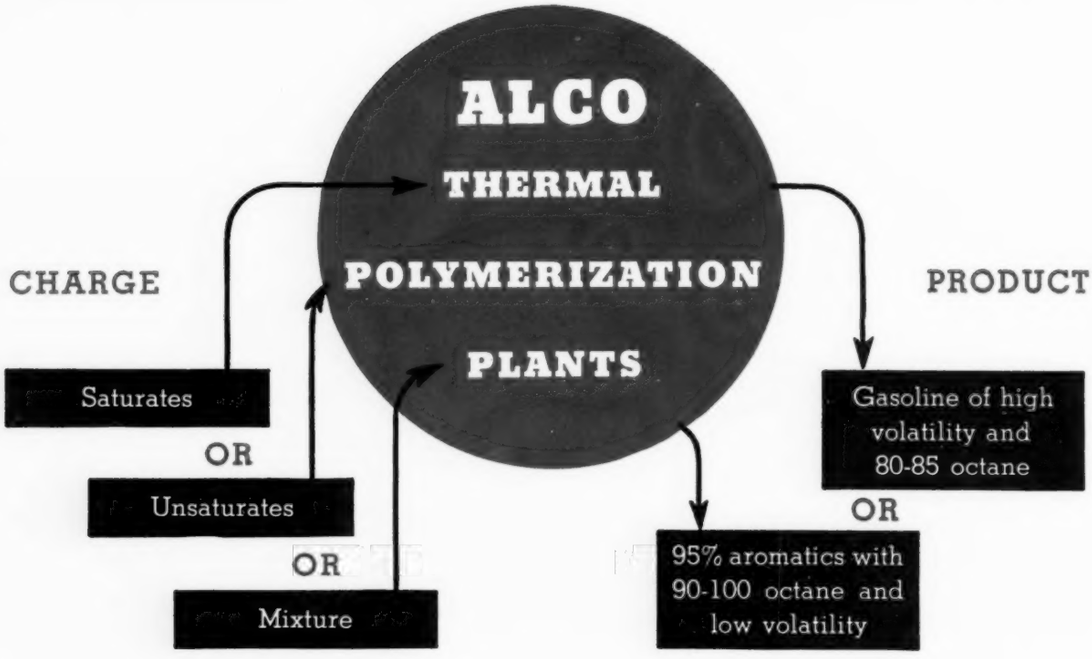

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APRIL
1936

WORLD PETROLEUM

VOLUME VII — **Editor, E. W. Mayo** — NUMBER 4

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Published Monthly by

RUSSELL PALMER

56 West 45th Street, New York, U. S. A.

Cable Address, Ruspam, New York and London

Advertising Manager, S. J. Gallay

Executive-Editor, T. Orchard Lisle

London: 3 Savoy Place, Victoria Embankment, W. C. 2

▼

OFFICES: Bendix Bldg., Los Angeles, Calif.
58 Sutter St., San Francisco, Calif.
Gulf Bldg., Houston, Texas.

Subscriptions

ANNUAL subscription to WORLD PETROLEUM is offered at the flat rate of five dollars (U. S.) postpaid to any country in the International Postal Union.

For the convenience of subscribers the publisher will accept payment in any of the following currencies at the fixed rate shown below:

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Remittances or drafts should be drawn to the order of the Publisher, WORLD PETROLEUM, payable in New York and London.

Subscriber's name and address should be in Roman capitals on the subscription order.

Official position of subscriber is requested.

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The price of a single copy is 2 shillings in countries of the British Commonwealth and the equivalent of 50 cents (U. S.) elsewhere.

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A departure from obsolete hit-or-miss methods in the search for new sources of oil—mapping the topographical features of the earth's surface by aerial photography. An oblique view showing the San Andreas Rift looking south across Carrizo Plains, with Soda Lake and Caliente Range in upper right-hand corner. Temblor Range is in the immediate foreground. The aerial camera (left) was designed for use in small airplanes and is operated either automatically or semi-automatically. Illustrations courtesy of Shell Oil Co. and Fairchild Aerial Surveys, Inc.

NEW YORK • WORLD • LONDON
PETROLEUM

Pulling Down the Pillars of Business

THERE are two things that may be said about the proposal of the Roosevelt Administration to place a heavy tax on the surplus funds of all corporations in the United States. The first is that the plan will by no means accomplish what its sponsors promise for it. The second is that even though it were capable of realizing the claims made in its behalf it should still be opposed as a devastating attack on the stability of American business and the security of American workers.

Reverting to the oft quoted dictum that the power to tax is the power to destroy it must be admitted that this is an exercise of the taxing power so destructive that it is astonishing to find it put forward by responsible governmental officials. The explanation undoubtedly is that it is merely another manifestation of the incurable desire of a well-entrenched group of bureaucrats to reverse the historic American concept that the state exists to preserve the rights and liberties of the individual and to reduce the entire citizenship to a position of absolute dependence upon the central government.

The new levy must not only provide the income of existing corporation taxes which it is to replace but it is relied upon also to supply a great part of the huge revenue required by the Administration in order to carry on its policy of lavish subsidization of certain classes of the population. To accomplish this result the tax itself must be drastic. An average rate of 33⅓ percent has been specifically stated in Congressional discussions as necessary to attain the Administration's objective.

To make the tax productive the penalty must be severe enough to force companies to distribute the funds ordinarily set aside to assure the continuity of their operations. According to the report current in Washington when the bill was brought before the House Appropriations Committee the coterie of Treasury "experts" who framed the measure estimated that in the ordinary course of events some $4,500,000,000 would be paid into surpluses in 1936. By forcing disbursement of this sum in dividends it would be brought within reach of the Internal Revenue authorities who could take toll of it in taxes and surtaxes laid upon hundreds of thousands of shareholders. By abolishing dividend exemption it would greatly increase the tax upon shareholders in the lower income brackets.

Like much of the legislation proposed in the name of the New Deal, however, the surplus tax is a double-barreled measure. Put forth in the guise of a revenue bill its deeper and more important effect would be to carry one step further the process of making all forms of business absolutely dependent upon the federal government.

JUDGED by the claims of its sponsors the greatest merit of the proposed tax, the feature that should rank it as one of the great economic discoveries of the age, is that by compelling the distribution of huge locked-up sums to millions of individual stockholders it will cause this money to pass into active circulation. The thesis is that the funds disbursed will be spent by the recipients and thereby will stimulate trade, increase the production of all those things that people want and so benefit all classes of the population. It is another variation of the Washington vagary that we can spend ourselves into prosperity.

The view on which this theory rests apparently regards the surplus maintained by any active business as a fund that is segregated from use, sterilized and withheld from its proper function of contributing to industrial activity. Pull the plug in the dyke that holds back these useless funds and you have a flood of wealth poured forth to lubricate the channels of trade exactly as you do when you hand out billions in a bonus to one class of citizens and other billions in benefit payments for abstention from production.

Such is the theory. What are the facts? Maintenance of a surplus, large or small, heretofore has been a recognized practice among all businesses that aspire to permanent existence. It is conceivable, though certainly exceptional, that such a surplus might be maintained as a cash deposit in bank. If so it serves

the purpose of other bank funds, being used as a basis of credit to facilitate commercial operations. If it is not being used by its actual owners it is nevertheless employed in serving the legitimate needs of the general business community.

Surpluses are much more likely to be invested in government and municipal bonds or corporate securities of one kind or another. In such cases these securities must be converted into cash before they can be paid out in dividends to meet the demands of the proposed law. Any such wholesale conversion must be attended by a serious depreciation in value which means that the surplus itself will shrink tremendously in the process of distribution, with a consequent disturbance of established values.

ALL these however are surface considerations that do not touch the real iniquity of this proposal as an attack upon American business. The primary purpose of building up a surplus in any business establishment is to enable that establishment to weather unfavorable conditions, to carry on its operations and to maintain its payrolls when profits have disappeared or to provide funds for additions to plant and necessary replacements of equipment when conditions justify expansion. In the past five years the country has had an overwhelming demonstration of the vital importance of such provisions. A majority of all the corporations in the United States have been able to keep going during that period only by utilizing the surpluses accumulated in more prosperous seasons. In four years of depression they paid out $7,000,000,000 more than they earned, this huge sum being taken from reserves built up over many years. Surplus has been drawn upon to provide employment for workers, perhaps in reduced numbers; to pay dividends, usually at reduced rates; to maintain the organizations intact and solvent. To prevent the upbuilding of normal surpluses must accentuate the severity of depressions, increase unemployment in dull times and retard the process of recovery from such unfavorable conditions.

All this presents no difficulty to the proponents of the new economy as practiced in Washington. If a company wishes to improve or expand plant and equipment, they point out, that is capital expenditure. Let it go out and raise fresh capital. In the totalitarian state toward which they aspire some arm of the government of course will decide whether companies may be permitted to expand and will fix the terms upon which they may be allowed to do so. To the question where the company shorn of its surplus is to find the money to pay wages when demand for its products has fallen off and to meet the many emergencies likely to be encountered in a world of fluctuating business conditions the answer is less clear, but it comes down to this: The corporation without reserve resources, like the farmers, wage earners and all others, must depend upon the aid or bounty of the government.

This proposal to wipe out the fundamental safeguard of business has proved to be somewhat strong medicine even for the hardy digestive organisms of Congressmen. Cautious members of the legislative body have advanced the suggestion that some minimum allotment to surplus should be exempt from taxation to form what they describe as a "cushion" against periods of depression. Some exceptions to the projected tax are necessary as in the case of corporations that have outstanding issues of bonds or preferred stock containing the requirement that no dividends shall be paid until provision has been made for meeting the prior claims of these issues. Other exceptions in the case of banks and insurance companies are necessitated by state laws. Against all concessions to sound business practice that are not absolutely compulsory, however, the representatives of the Administration have set their faces sternly. To grant exemptions of any sort, they say, would impair the efficiency of the act and besides it would upset the principle of equality in taxation. This principle of equality to which they refer is a typically bureaucratic conception. It holds that a fixed rule can be laid down to cover the requirements of all kinds of businesses regardless of their size or the relative hazards they are called upon to face. Every man who has had the slightest practical experience knows that this is not the case, that a reserve sufficient for a small concern operating in a local area might be totally inadequate for a large corporation covering a much broader field and facing many more uncertainties and diversities of condition.

This is a point of particular concern to oil companies in connection with the proposed surplus tax. Petroleum corporations in the main will be affected the same as other corporate enterprises by this new scheme for the distribution and depletion of their surplus holdings. There is, however, one important difference. Because the oil industry, more than most others, is subject to violent fluctuations in earnings, because it is an industry in which the risks are unusually great and the margin of profit ordinarily narrow, because the exigencies of its situation may necessitate the making of heavy expenditures on short notice, it is particularly important for companies operating in this field to maintain surpluses of substantial volume. Perusal of the reports of ten American oil companies shows that in the four year period 1931–34 these companies drew upon surplus for $380,000,000. Since only a small part was disbursed in the form of dividends it is obvious that these millions helped to pay wages, extend development and maintain the operations of these companies on a "business as usual" basis when business was far from usual.

An oil company faced by the necessity of entering upon an extensive drilling campaign to protect its holdings in a particular field or building a pipe line to handle oil from a newly discovered pool would have no time, even if it had the financial ability, to float a bond issue. There are many other emergencies that may arise to require large and immediate expenditures for which provision can be made only through a substantial surplus.

IN ONE respect, however, the proposal may logically be welcomed by the large integrated oil companies—equally of course by other large corporations. Through recognition of the special requirements of their businesses most of these companies have built up surpluses of considerable volume which the tax cannot affect. If the proposed bill becomes law new companies entering the field and attempting to compete for a share of it will be handicapped in their operations. As a result the established companies will be helped in maintaining their position by a law of the kind now under discussion.

At the present writing the proposed tax is still in the hands of a Congressional committee and has not even assumed the form of a bill. There is no telling what changes or modifications may be made in it. But none of these considerations diminishes the fundamental unsoundness and unwisdom of the original proposal.

War Factor in Germany's Oil Policy

Effort to Expand Domestic Output, Encouragement of Coal Hydrogenation and Search for Substitute Fuels Dictated Largely by Fear of Possible Blockade.

GERMANY'S efforts to develop substitutes for petroleum products have been more intensive than those of any other nation. As a natural consequence they have aroused much discussion both in scientific and trade circles. The reason usually assigned to explain why the German government is constantly encouraging experiments with motor fuels and is willing to spend vast sums in subsidizing processes that are admittedly uneconomic is a financial reason—the desire to reduce expenditures for imported goods to a minimum. This obviously is a factor but it probably is the minor factor. The compelling reason behind Germany's feverish search for means of freeing herself from dependence upon imported oil supplies undoubtedly is military necessity, or at least what is regarded as that in official quarters.

Italy's recent experience, the efforts of the League of Nations to apply sanctions against her, has not been lost upon Germany. Even without that example it is obvious that in the event of a European conflict Germany's supplies of oil from outside sources might be completely or almost completely shut off. Since military experts agree that in a modern war victory will rest eventually with the side possessing superior material resources and equipment it is easy to understand the urgent nature of the petroleum problem as it presents itself to German officialdom.

First and most important among the reasons for exploring the possibilities of petroleum substitutes is the inadequacy of the domestic oil supply. German consumption of motor fuels is estimated at between 1,800,000 and 1,900,000 metric tons and is increasing yearly. Production of gasoline from domestic crude was 95,000 tons in 1935 or approximately five percent. Crude oil output from German wells was 429,673 tons last year, the highest in the history of the industry. Of this 98 percent came from fields in Hanover. Exploration and drilling is being officially encouraged and backed by government loans. Drilling in 1935 amounted to 175,000 metres and it was reported that oil was discovered in six new locations. There is, of course, a possibility of other and more important discoveries but the weight of geological opinion is against the development of large producing fields. Wells in the potash mines of Thuringia for which high hopes were entertained have steadily declined in production. Nevertheless the exploration of all promising areas will be energetically pushed. The importance of even small producing wells is so great that none must be overlooked.

Aside from the output of local fields Germany's principal recourse for the production of motor fuel is found in her coal mines. Within the past three years the yield of gasoline from coal and lignite by hydrogenation has been brought up to 260,000 metric tons. This is the output of the great Leuna works the capacity of which is being further enlarged. The process employed is that developed by Dr. Bergius and controlled by I. G. Fahrbenindustrie under patents shared by the Imperial Chemical Industries of England and the Standard Oil Company of New Jersey in the United States.

During the past year or two a great deal of attention has been attracted by the Fischer process which uses coke water gas as its basis. Divergent opinions regarding the merits of this process have been expressed by experts. On the one hand it is contended that it is a more economical system than that of Bergius while on the other it is asserted that its products are not of equal quality. There is ample confidence in it on the part of coal, coke and chemical interests of the Ruhr who have organized Ruhrbenzin A.G. to erect a plant of 25,000 tons capacity. This plant is expected to be ready for operation during the latter part of the year. Three other plants using this process are in operation. By the end of the current year production from this source will be brought up to 450,000 metric tons.

Benzol and alcohol mixed with gasoline in Germany amounted to roundly 450,000 tons last year. Thus, from domestic sources, including admixtures, Germany is able to provide about 800,000 tons of motor fuel annually and this amount will be somewhat increased by facilities now being provided. The remainder of the motor fuel requirements of the country are imported. Imports during 1935 are officially reported as follows in metric tons:

Roumania	527,425
Soviet Union	152,785
United States	101,337
Other America	203,127
Great Britain	105,603

Imports of crude oil into Germany during 1935 amounted to 515,298 tons of which 295,871 tons came from Mexico, 178,113 from the United States, 21,684 from Venezuela and 19,628 from Roumania. In addition 229,292 tons were imported into the free port of Hamburg. A considerable part of the products derived from the refining of this crude is reexported and this is particularly true of the great new refinery of the Europaische Tanklager and Transport A.G., erected in the free port of Hamburg in 1935.

In addition to this new plant there are six large companies operating refineries in Germany besides a number of smaller ones. These are Rhenania-Ossag Mineraloelwerke, Deutsche Petroleum A.G., Deutsche-Amerikanische Petroleum Gesellschaft, Deutsche Vacuum Oel A.G., Mineraloel and Asphaltwerke, A.G., and the Ebano Asphaltwerke. These refineries work some crude oil from German fields but are mainly supplied from outside sources through the international companies with which they are affiliated. As previously stated the only German fields in which production is showing a material increase are those of Hanover. The Deutsche Erdoelraffinerie, which deals with oil from this area, is increasing its capacity to 200,000 tons annually.

At the present time Germany's situation is this: By intensive development of local fields, by subsidizing production from coal through relatively costly methods, and by requiring the admixture of benzol and alcohol she is able to supply 40 percent or a little more of her motor fuel requirements. Her refining capacity is limited and she must still depend upon imported products for the major part of her requirements. The practical question

(Continued on page 180)

U. S. Losing Ground in Export Trade

While Sales of Crude to Other Countries Have Increased, Proportionate Share of International Trade in Petroleum Products Is Declining—A Study of Trends.

By Paul L. Hopper

Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce

Shipments from the United States to other countries of petroleum and its products exceed in value any other single class of export commodity except cotton. They represent roughly one-eighth of the total value of the country's exports. While their volume declined after 1930 they have shown a substantial gain from 1933 on.

The question that interests the trade observer is whether this growth will continue or whether, possibly after two or three years, a gradual decline will set in. Surface indications point to the maintenance of increased exports but there are other reasons for believing that the world will look less and less to the United States for petroleum and its derivatives. The facts in the situation and some of the trends are examined in the accompanying article.

Petroleum and its products sold abroad by the United States in 1935 had a value of $249,100,000, a gain of $21,600,000 over 1934 and $49,100,000 above the worst depression year, 1932. These figures exclude bunker sales amounting to $29,400,000, $31,300,000 and $29,900,000 in 1932, 1934 and 1935 respectively. Improvement in the export position during 1935 emphasized the rising trend of crude shipments which has been particularly noticeable since 1932. Crude represented 6.7 percent of the total value of all petroleum exports in 1929. Five years later it had risen to 20 percent and by 1935 it was 24.7 percent.

Without attempting to analyse the causes responsible for this shift it is obvious that there is a certain national disadvantage in exporting raw products instead of refined. The country loses the return to labor and capital that would have accrued from processing at home the more valuable refined products. On the other hand the expansion of refining facilities in other countries requires increasing supplies of crude and these will be had elsewhere if not procurable on equal or better terms from the United States.

Before considering the relative importance of various export outlets for American petroleum products it will be instructive to look at the table on page 178 showing the principal countries exporting refined oils and to glance at the chart showing the value of petroleum and products purchased by the 25 countries that were the heaviest buyers in the period 1929–1934. These data, based on official trade statistics, are admittedly incomplete but their interpretation is not difficult. Here at a glance is revealed the increasing share in the international petroleum trade obtained during the past five years by other countries at the expense of the United States resulting from various causes.

As shown on the graph, from a value of $715,000,000 in 1929, exports of petroleum and its products plunged headlong to $237,800,000 in 1932 and eased still downward to $227,100,000 in 1933 before an upward trend asserted itself. Export of gasoline suffered most heavily, dropping to $54,000,000 or only 20 percent of its 1929 value in 1934. Other refined products followed a similar course. In 1929 exports were 14 percent of production; in 1934 and 1935 only 5½ percent.

Inspection of the chart dealing with purchases abroad shows the combined value of petroleum and its products sold by the United States to its 25 most important customers in 1929, what they bought in 1934, and the difference. Examination of incomplete data covering 1935 exports from the United States reveals few material changes in the relative position of purchasing countries since 1934.

One noteworthy change that appears is that Canada has displaced the United Kingdom as the most important market for petroleum exports from the United States. It seems likely to retain that position for many years. Only Japan and the Netherlands West Indies remotely approximated their 1929 purchases in 1934. Japan has steadily built up its domestic refining industry, using increasing quantities of crude from the Pacific Coast which is particularly adapted to Japanese refining practice. Considerable quantities of refined oils go from the United States to Aruba and Curacao for blending with Venezuelan oils in the refineries there.

From the time when it ousted kerosene from first place until 1934 gasoline remained the most valuable petroleum product exported from the United States. In the latter year sales of lubricants abroad were higher by $10,000,000. In 1935 gasoline regained first rank.

Gain or loss in exports of petroleum and refined oils to the heaviest consuming countries from 1930 through 1935 is indicated in Table II. Following are analyses of the more important world markets absorbing considerable quantities of American petroleum products.

Gasoline exports to the United Kingdom in 1935, accounting for one-quarter of the export sales of gasoline by the United States, exceeded the 1934 figure of 4,338,000 by 2,230,000 bbl. Britain's total gasoline imports in 1935 were 33,311,000 bbl. Of this Netherlands West Indies furnished nearly 44 percent, Iran almost 23 percent and the United States approximately 14 percent. In 1930 this American gasoline constituted half the

total quantity imported into the United Kingdom; Iran supplied about 12 percent and Netherlands West Indies less than 1,000,000 bbl.

France offers a striking example of mounting crude purchases with curtailed imports of refined. In 1930 some 16,280,000 bbl. of gasoline were imported, 55 percent from the United States. Even with a gain of 750,000 bbl. over 1934 gasoline exports to France last year were but 2,370,000 bbl., just over one-ninth of the French gasoline consumption in that year. Domestic production amounted to 14,335,000 bbl.; imports were 4,690,000 bbl. of which the U.S.S.R. and Roumania supplied most after the United States. During 1935 French supplies of motor fuel were augmented by approximately 2,500,000 bbl. of alcohol.

Since Belgium serves as distributing center for much surrounding country a considerable quantity of petroleum products entering Belgium are not included as imports for consumption. From 2,000,000 to 2,500,000 bbl. of gasoline are imported annually for use in Belgium. In 1934 these imports were proportioned principally among United States 28, Roumania 22, Iran 21, and Netherlands West Indies 16 percent. In the case of Spain that country's petroleum monopoly, the Compania Arrendataria del Monopolio de Petroleos, S. A. in 1935 doubled its American gasoline purchases of the preceding year, taking 1,900,000 bbl., thus enabling the United States to exchange places with the U.S.S.R. which formerly supplied well over one-half of Spain's imports.

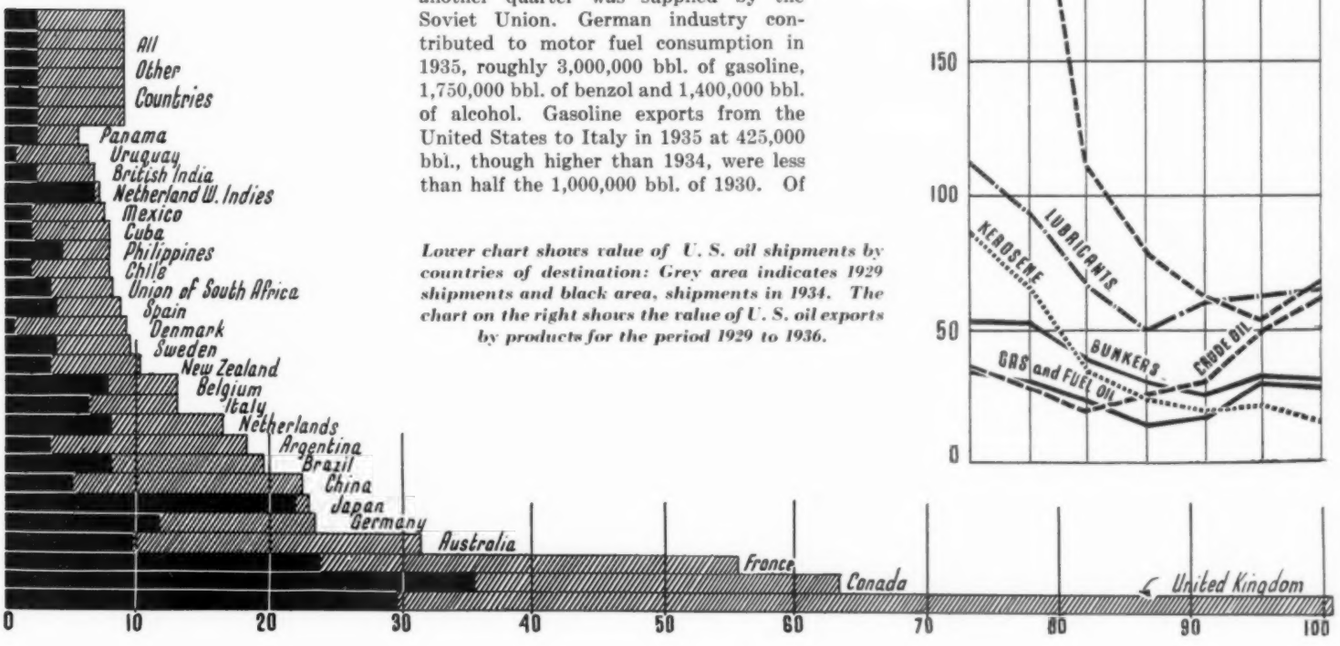
Recent data as to the origin of imports for the Scandinavian area are lacking but of the total imports of gasoline in 1935 Sweden 3,300,000 bbl., Norway 1,200,000 bbl., and Denmark 2,100,000 bbl., direct shipments from the United States contributed substantially less than in 1930 when American gasoline dominated that trade. Roumania and Russia have captured business in that area and transshipments from England and Europe have become more important.

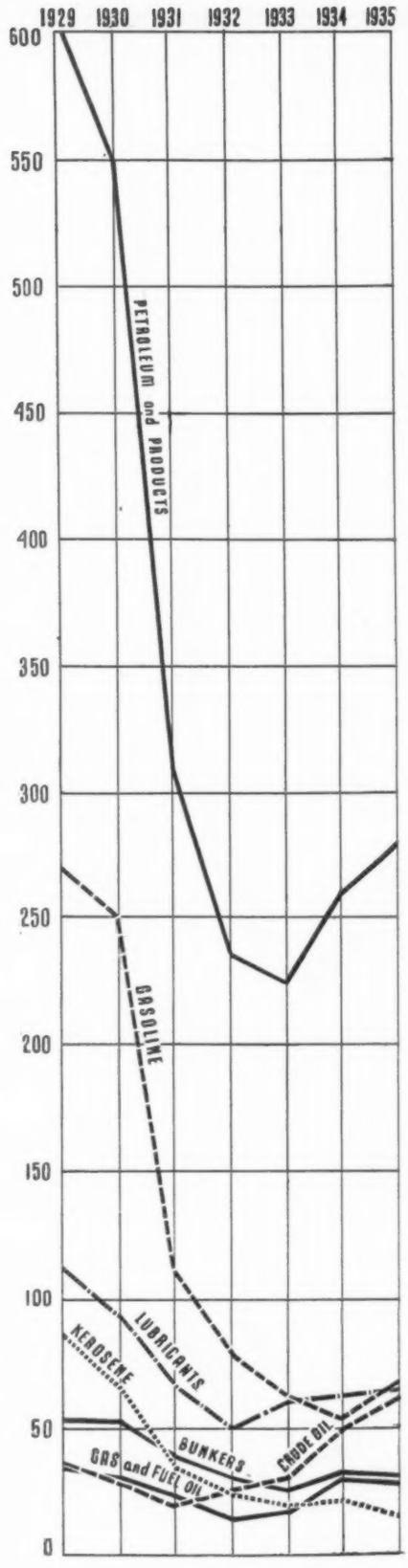
Until two years ago Australia divided the bulk of its 5,500,000 to 6,000,000 bbl. of gasoline imports between the United States and Netherland India with the former receiving the larger share. Figures for 1935 probably will show Netherland India supplying close to 75 percent with the United States under 25 percent. American gasoline predominated to the extent of 80 percent in New Zealand during 1930. In 1934 the United States furnished but 34 percent of that country's imports of 1,850,000 bbl., most of the remainder coming from Netherland India.

Canada currently supplements domestic production with 1,000,000 to 1,500,000 bbl. of gasoline each year, nearly all of which comes from the United States. In 1930, before domestic refining reached present proportions, imports across the border exceeded 4,000,000 bbl.

Just under 40 percent of Brazil's gasoline imports in 1934 were from the United States, a six percent decrease from 1930. Nearly as much more was furnished by Peru; Mexico and Netherlands West Indies were the sources of the remainder. In 1935 the United States exported nearly 1,200,000 bbl. of gasoline to Brazil. As would be expected, practically all of Cuba's gasoline imports come from the United States; current imports are considerably under the 1930 figure of 1,000,000 bbl. A large local refinery meets the bulk of the Island's demand for motor fuel.

Most of the remaining countries taking 500,000 to 750,000 bbl. of American gasoline in 1935, buy more elsewhere. Nearly half of Germany's 1935 imports of 10,065,000 bbl. originated in Roumania and another quarter was supplied by the Soviet Union. German industry contributed to motor fuel consumption in 1935, roughly 3,000,000 bbl. of gasoline, 1,750,000 bbl. of benzol and 1,400,000 bbl. of alcohol. Gasoline exports from the United States to Italy in 1935 at 425,000 bbl., though higher than 1934, were less than half the 1,000,000 bbl. of 1930. Of





Lower chart shows value of U. S. oil shipments by countries of destination: Grey area indicates 1929 shipments and black area, shipments in 1934. The chart on the right shows the value of U. S. oil exports by products for the period 1929 to 1936.

Table I

Exports of Crude Petroleum and Refined Oils by Principal Exporting Countries 1930, 1933 and 1934

(In Thousands of Barrels)

Countries	Crude Petroleum			Gasoline			Kerosene			Lubricating Oils			Gas Oils			Fuel Oils		
	1930	1933	1934	1930	1933	1934	1930	1933	1934	1930	1933	1934	1930	1933	1934	1930	1933	1934
United States	23,704	36,584	51,430 *	63,195	25,996	28,366 *	16,690	8,764	6,455 *	9,850	8,147	8,305 *	...	10,232	14,351 *	32,378	8,223	11,374 *
Netherlands West Indies	...	...	...	17,042	21,480	26,983 *	104	2,750	3,292 *	831	670	1,375 *	6,640	11,521	12,830 *	59,305	51,936	68,171 *
Roumania	486	1,647	3,348 *	9,516	14,936	16,591 *	7,298	7,369	9,034 *	499	416	434 *	3,970	7,545	8,200 *	7,350	11,931	12,734 *
Netherland India	6,005	3,455	4,042	11,070	10,903	12,444	3,922	4,122	4,453	185	145	145	6,684	4,742	5,205	8,592	5,026	5,375
U.S.S.R.[1]	1,649	5,905	5,595 *	8,660	11,795	5,595 *	6,061	3,918	3,226 *	1,603	1,668	2,155 *	2,730	...	4,377 *	13,093	15,242	7,550 *
Iran[1]	11,778	9,334	10,959 *	10,511	12,720	12,954	7,201	2,156	3,450	13	1,008					10,203	17,765	24,959
Peru	7,711	6,936	9,459	2,412	3,020	3,315	147	238	300	12	5	7		334	517	731	1,091	830
Poland	...	...	...	346	426	357 *	230	352	233 *	258	223	126 *			225 *	318	182	
Mexico[3],[1]	12,714	11,085	11,798	5,698	2,895	3,610					344	342		1,427	1,245	8,138	5,457	6,387
Trinidad	3,382	1,170	470	1,523	2,177	2,609	52	82	72							5,025	5,526	6,809
Venezuela	138,305	112,815	131,458	185	370	401								434	363		4,749	5,366
British Borneo	871	915	102	1,289	671	793	417	267	108	...	...	...		588	687	1,646	1,365	2,936
Argentina	...	...	...	...	37	64	...	33	7	...	...	...	...	7	48	53	832	758
Germany[2]	...	...	...	58	67	461 *	...	...	60 *	701	542	652 *	99	229	248 *	67	...	294 *
United Kingdom	...	...	...	911	1,293	2,274 *	416	263	233 *	172	190	374 *	149	537	671 *	5,571	354	...
France	...	...	...			643 *						505 *			510 *			1,562 *
Colombia	19,113	11,806	15,949 *															
Ecuador	1,128	943	1,401															
Iraq	...	...	23,450 *			9												4,187

* Data for 1935 in place of 1934.

[1] Data under 1930 actually for 1929–1930.

[2] May include re-exports.

[3] 1930 figures lump gasoline, kerosene and lubricating oils together and gas and fuel oils are combined.

[4] Kerosene included with gasoline in 1933 and 1934.

Data from official trade statistics of governments.

the 3,000,000 bbl. imported in 1934, Iran supplied one-third, U.S.S.R. one-quarter, Roumania and Netherland India most of the rest, the United States' share being just over six percent. Italy supplements its annual supply of motor fuel with 50,000 to 60,000 tons of alcohol mixed with gasoline.

American gasoline dominates motor fuel imports in the Philippines where consumption, still small, nevertheless expanded from 300,000 bbl. in 1930 to over 1,100,000 bbl. in 1935. In the Netherlands' 3,000,000-bbl. gasoline market the share of the United States has been reduced from two-thirds to less than one-third, with Netherlands West Indies the gainer. In 1930 nearly half of South Africa's 2,000,000 bbl. of gasoline came from the United States; in 1934 less than one-quarter. Iran has benefited by the American loss plus a consumption gain of 700,000 to 800,000 bbl. Formerly Japan divided most of its gasoline imports of 2,500,000 to 3,000,000 bbl. each year about evenly between the United States and Netherland India. Now the latter country obtains well over half and the former less than one-third of this trade.

Lubricant exports, long ranked second to gasoline exports in value, actually exceeded the latter by $10,000,000 in 1934, but were overtaken by exports of gasoline during 1935. From 30 to 35 percent of the lubricants produced in the United States are exported. The qualities of American lubricating oils are so universally appreciated that some demand exists wherever machinery is in operation. Accordingly it is not surprising to find United States lubricating oils dominant in practically all the world's markets, a position sustained for many years.

Although taking somewhat less than formerly the United Kingdom is still the best outlet of the United States for lubricants, buying 1,855,000 bbl. of lubricating oils and 14,702,000 lbs. of lubricating greases in 1935. Exports of 516,000 bbl. of lubricating oils and 3,854,000 lbs. of lubricating grease to France were approximately half the 1930 amount. Exports of lubricating oils and greases to Germany at 922,000 bbl. and 7,888,000 lbs. were slightly under 1934 purchases but still 90 percent of the 1930 figures. Belgium has nearly regained its 1930 level of buying, taking 716,000 bbl. of oil and 5,237,000 lbs. of greases in 1935. Exports of lubricating oils and greases to Italy during 1935 were almost exactly the 1930 figure of 460,000 bbl. of oil, 3,500,000 lbs. of grease. Canada increased its 1934 purchases of lubricating oil over 315,000 bbl. or 33⅓ percent in 1935. Well over half of the "batching" oil, a type of lubricating oil used for treating jute in British India comes from the United States and in addition roughly two-thirds of the ordinary lubricants used in India, amounting to 320,000 barrels in 1934, originate in this country.

If shipments of Venezuelan crude to Curacao and Aruba for refining are excepted, the United States is the world's largest exporter of crude petroleum. Sales to other countries have mounted steadily since 1931. In 1929, three percent of the domestic crude production was exported and the ratio of crude exports to the total of all petroleum and its derivatives exported was 6.7. By 1935, the crude sent abroad was 5.2 percent of the total output and it accounted for just under 25 percent of the value of all crude petroleum and refined products exported.

In recent years Canada has taken roughly one-half of the exports of crude petroleum from the United States. Expressing it the other way around about 75 percent of the crude imported into Canada comes from the United States, the remainder coming from Colombia, Venezuela and Peru. Canada's 42 refineries of 159,000 bbl. daily capacity used just over 33,000,000 bbl. of crude in 1935, and United States fields supplied 80 percent of the 2,500,000 bbl. increase over the preceding year.

Argentina still imports crude to the extent of 1,000,000 to 1,500,000 bbl. to supplement domestic production. With exports of 1,100,000 bbl. to that country in 1935 the United States has returned to its 1930 status as the chief source of Argentina's crude imports. In the interval Peru enjoyed the bulk of this trade.

Between 1930 and 1934 the capacity of refineries in France increased from 11,250 to 138,000 bbl. daily and concomitantly imports of crude climbed from 3,200,000 to 31,000,000 bbl. Prior to 1934 no crude was imported from Iraq; in that year nearly 3,700,000 bbl. were received in France and during 1935 just under one-half of France's 39,400,000 bbl. of crude imports came from Iraq. In 1930 the United States sold France less than 1,000 bbl. of crude petroleum; in 1933 sales had risen to 7,800,000 bbl. and during 1935 they were over 10,300,000 bbl.

Kerosene seems the weak sister of the refined petroleum oils and its exports from the United States appear destined to decline continuously and all but dry up. Although kerosene may become more important as power fuel the greatest demand is still as an illuminant. China, India and other countries in Asia still consume enormous quantities of kerosene, but American kerosene in that part of the world cannot stand freight and handling in competition with kerosene from Iran, Netherland India and Russia. Exports which accounted for 36 percent of production in 1929, dropped to 18 percent in 1934 and 11.6 percent in 1935. From just under $85,000,000 in 1929 the value of kerosene exports has declined per-

sistently each succeeding year, reaching $15,000,000 in 1935.

Curiously Netherland West Indies was the destination of the largest kerosene exports in 1935—nearly 1,000,000 bbl.—and this trade is of recent development as under 5,000 bbl. was exported to those islands in 1930. Brazil imports approximately 750,000 bbl. of kerosene annually, 75 percent of which originates in the United States; Venezuela and Mexico supply the remainder.

The United Kingdom obtained more than one-third of its kerosene requirements from the United States in 1930, but in 1935 the latter furnished less than eight percent of the 5,500,000 bbl. imported.

Imports of kerosene into China, excluding Hong Kong and Manchukuo between 1933 and 1935 decreased nearly 50 percent. In 1930 the United States supplied 70 percent of China's kerosene; by 1935 its share of the 2,500,000 bbl. of kerosene imported was about 46 percent.

Exports of gas oil, distillate fuel oil and residual fuel oil progressively declined in value at the rate of about $7,000,000 annually through 1929–1932, rallied cautiously in 1933, climbed to $27,000,000 in 1934 and declined slightly in 1935. The proportion of liquid fuel exported to gas oils and fuel oils produced has remained around eight percent since 1929, except during 1932 and 1933 when it dropped to six percent. Exports of gas oil and distillate fuel oil were approximately 1,000,000 bbl. above 1934, residual fuel oil 1,250,000 bbl. less.

Fuel oils and gas oils are sold principally in bulk and their distribution does not require extensive marketing organizations which develop brand preferences as with gasoline, kerosene, and lubricants. Heavy fuel oil is of fairly uniform quality wherever obtained; therefore users are inclined to buy where economical and convenient. So are partly accounted for the shifts from one source to another by leading importing countries. Bunker oil sales are influenced to an even greater extent by availability and cheapness. In 1929, 52,278,000 bbl. of bunker oil, worth $55,000,000, were taken aboard vessels in American ports. Declining demand persisted through 1934 when 29,899,000 bbl. were disposed of. Only 400,000 more bbl. of bunker oil were sold in 1935, an indication that shipping is recovering slowly.

West Indian ports located close to or on the run to the Panama Canal have taken the bunkering business from Panama in recent years. In 1930 nearly 3,000,000 bbl. of gas oil and fuel oil were exported from the United States to Panama. In 1934 these shipments had dropped to 2,100,000 bbl. and in 1935 they were only 903,000 bbl.

While the growing competitive strength of various producing countries accounts in part for the declining importance of the United States in the international field another reason for this development is to be found in the progress made by leading consuming nations which permits them to rely less extensively than formerly upon the United States as a source of petroleum supplies.

Among the countries striving for the fullest possible measure of national petroleum sufficiency the Germans, possessing an abundance of suitable coals and highly skilled in the chemistry of fuels, have progressed furthest in the manufacture of synthetic oils. At the same time not to be minimized is their success in raising the output of natural petroleum in Germany now nearly equal to crude imports—around 3,500,000 bbl. annually.

In contrast to Germany, France has developed a domestic refining industry capable of supplying nearly the whole of the country's requirements of petroleum products from imported crude, but only recently has become interested in the manufacture of synthetic oils. France now buys crude from many sources, but intends to rely more and more on the fields in Iraq.

Although deficient in petroleum the United Kingdom has ample coal for conversion into oil, and through financial control Britain has a substantial, often major, share of production in many of the world's large oil fields outside Russia and the United States. To determine the possibilities of domestic production a thorough campaign of exploration and drilling in England is now being put under way. Britain also has become interested in coal hydrogenation and expects to have 1,275,000 bbl. of plant capacity in operation by the end of 1936. As encouragement for this venture the production of gasoline from coal has been guaranteed a protection of at least 4d per gallon.

The most intensive exploitation of Japan's meager petroleum resources is sufficient to supply but 20 percent or less of the country's needs. Consequently further effort is being directed to the ex-

Table II

United States Exports of Crude Petroleum and Refined Oils by Countries of Destination

(Thousands of Barrels)

	Crude Petroleum		Gasoline		Kerosene		Gas Oil and Distillate Fuel Oil	Residual Fuel Oil		Lubricating Oils		Lubricating Greases	
	1930	1935	1930	1935	1930	1935	1935	1930	1935	1930	1935	1930	1935
Belgium	...	93	1,801	1,616	178	124	...	514	...	783	716	5,073	5,237
Denmark	36	...	1,601	...	355	...	...	459	...	166	196	641	821
France	...	10,348	9,331	2,731	769	1	66	334	...	1,475	516	7,176	3,854
Germany	755	1,531	2,254	684	493	6	747	2,006	...	1,054	922	7,390	7,888
Italy	1	1,607	1,029	423	227	...	770	106	179	461	464	3,531	3,306
Netherlands	...	151	1,584	837	1,318	519	779	1,002	...	228	336	2,668	2,829
Spain	145	53	1,844	1,902	50	...	177	237	279	103	72	1,687	1,254
Canary Islands	...	78	7	...	42	...	...	5	...	4	...	65	...
Sweden	51	270	1,265	1,048	266	298	280	232	...	119	93	665	1,183
United Kingdom	165	411	19,208	6,568	2,945	752	1,260	3,010	151	2,099	1,855	14,304	14,702
Canada	18,967	24,413	4,282	1,419	124	44	517	2,244	1,025	481	433	6,559	4,222
Mexico	24	115	488	210	152	21	191	2,055	896	74	61	1,729	1,889
Cuba	512	92	1,186	560	104	42	68	2,090	294	65	51	3,416	2,914
Panama	...	...	337	192	43	37	1,070	2,973	807	20	11	274	235
Netherlands West Indies	...	...	2,863	663	4	986	451	774	...	7	4	124	133
Argentina	68	1,112	1,488	18	124	...	...	289	...	238	59	3,795	607
Brazil	...	...	1,188	1,162	557	524	42	232	...	157	229	2,459	1,519
Chile	4	50	352	144	2	...	348	4,262	1,262	58	44	2,167	1,126
Uruguay	...	...	482	252	195	95	36	2	345	33	22	787	434
British India	...	...	...	9	770	...	22	7	62	509	426	2,679	2,379
China	...	...	413	204	2,412	481	82	621	157	194	181	2,999	3,782
Japan	2,926	10,433	1,069	699	1,074	60	5,129	5,694	4,163	248	282	5,627	6,922
Philippines	...	...	475	1,079	427	446	199	532	499	70	71	2,182	3,150
Union of South Africa	...	47	760	745	409	150	25	83	...	79	96	1,816	1,849
Australia	...	...	3,009	2,233	696	278	3	53	...	305	416	4,858	6,981
New Zealand	...	...	1,519	544	136	24	35	856	824	87	68	1,869	1,691
Total	23,704	51,430	63,195	28,366	16,690	6,455	14,351	32,378	11,334	9,850	8,305	99,275	94,552

Note: Gas Oil included with Fuel Oil in 1930. 1935 figures subject to correction.
Lubricating Greases in thousands of pounds. Data from U. S. Department of Commerce.

pansion of shale refining at Fushan. These plants are expected to reach an annual capacity of 200,000 metric tons by the end of 1936 and eventually to become an important source of fuel for the Japanese navy. Hydrogenation is being investigated and the 100,000-ton low temperature carbonization plant at Karafuto is to have its capacity tripled. The marketing of petroleum products in Manchukuo has been made a monopoly of the government-sponsored Manchurian Oil Company whose supplies will come chiefly from the semi-official refinery "Maushu Sekiyu K.K." at Darien. The capacity of this plant is to be increased shortly from 50,000 to 120,000 metric tons a year.

Having very little coal and less petroleum Italy has turned to oil fields abroad. The A.G.I.P. with government backing has bought into Roumanian oil companies, acquired a substantial stake in Mosul Oil Fields, Ltd., owner of valuable properties in Iraq, and secured a blanket concession to exploit the oil resources of Albania. If expectations are realized, Italy should be able to obtain an increasing proportion of its petroleum requirements from areas in which Italian capital is heavily invested.

Leaving the five countries mentioned as lacking adequate natural petroleum within their national boundaries, a sweeping glance to other parts of the world reveals the compulsory mixing of alcohol, benzine or benzol with gasoline in several countries; the increased use of these substitute fuels being encouraged wherever ample petroleum is lacking; serious consideration of coal liquefication where suitable coal is found; expansion of shale oil refining in Estonia, South Africa and Manchuria; experimentation with various types of gases for internal combustion engine propulsion; national petroleum monopolies of varying degrees of control; and finally intensification of the struggle for oil concessions only less keen among little nations because of their limited political strength and smaller financial resources.

Discussion of the various factors affecting all international commerce; periods of curtailed demand, price differentials, exchange restrictions, tariff barriers, barter agreements and the like, have been intentionally avoided, the purpose being rather a long term analysis of forces and developments peculiarly affecting the petroleum industry.

Table III

Quantity and Value of U. S. Exports of Petroleum and Products 1934–1935

		Quantity*	Value**
Crude petroleum	1935	51.430	61.167
	1934	41.122	49.751
Gasoline	1935	28.366	67.051
	1934	23.180	54.113
Kerosene	1935	6.455	15.149
	1934	9.607	20.792
Gas oil	1935	14.351	17.484
	1934	13.434	17.811
Fuel oil	1935	11.334	9.533
	1934	12.490	10.387
Bunker oil	1935	30.304	29.925
	1934	29.899	31.264
Lubricating oil	1935	8.351	62.358
	1934	7.616	58.869
Lubricating grease	1935	94.552	4.002
	1934	83.500	3.651
Paraffin wax	1935	230.118	7.625
	1934	199.243	7.833
Asphalt	1935	198.951	3.371
	1934	200.972	3.381
Coke	1935	119.228	916
	1934	102.025	663

* Oils in thousands of barrels; greases and wax in thousands of pounds; asphalt and coke in tons.
** In thousands of dollars.

German Oil Policy

(Continued from page 175)

with which she is confronted is what policy to adopt for the future. Shall she continue to underwrite the economic loss involved in pushing production from coal by hydrogenation and other expensive processes or shall she rest content for the present with the progress made in this direction and rely upon imports for, say, half her annual needs?

If the answer were to be dictated by economic considerations alone the latter course undoubtedly would be adopted. Cutting down imports reduces governmental revenue from the rather high duties on petroleum products. Motorization of the country, which is one of the aims of Reichsfuhrer Hitler, would be accelerated by providing motor fuel as cheaply as possible. But here again the military factor comes into play. A motor fuel supply that might be reduced to half its normal proportions does not conform to the ideas of the military strategists and hence there is every likelihood that efforts to obtain oil from coal will be pushed still further, regardless of cost.

One other line of effort designed to reduce the country's requirements of gasoline is being encouraged in every possible way. This is the development of other means of motor propulsion such as compressed gas carried in drums, wood and charcoal gas produced in converters and the use of steam and electric driven vehicles. Except under special or emergency conditions, none of these afford much promise of seriously affecting the demand for gasoline.

Great interest exists in the possibilities of polymerization as a means of obtaining gasoline from the gases of coking ovens and other similar sources. Investigations along this line are under consideration, if not yet under way. In any case polymerization plants are likely to be erected in Germany as a means of adding to the domestic output of gasoline.

While reference has been made thus far mainly to gasoline, other petroleum products are of course important to Germany. The rapid spread of the Diesel engine, which has reached the point where practically all trucks, omnibuses and river steamers are equipped with this type of motor, has resulted in a corresponding growth in the demand for gas oil. In 1935 supplies of this form of fuel amounted to over 950,000 metric tons of which only 106,000 tons were from domestic sources. Fuel oil for domestic and industrial uses and for bunkering ships used in 1935 amounted to 583,000 tons, of which 330,000 tons were imported. Imports of lubricating oil last year amounted to 353,000 tons as compared with 87,500 tons produced domestically. An argument against too great an expansion in the production of synthetic products is the difficulty of maintaining a balance between the different products required. In its broad aspects, however, the same considerations apply to these other products as to gasoline itself.

While the provision of petroleum products to meet growing peace-time needs presents a serious problem, that problem would be vastly intensified in the event of war. A mobilized Germany with thousands of tanks, trucks and other vehicles, other thousands of airplanes, and a naval force to which oil is indispensable would need double or triple the quantities now consumed. Instead of 4,000,000 tons annually the figure would be 10,000,000 to 12,000,000 tons. Demand for motor fuel and lubricants would jump to twice the current requirements while the use of gas oil and fuel oil would increase in still greater proportion. How and where to obtain this augmented supply is the question that is stimulating intense interest in synthetic gasoline and substitute fuels.

Because war multiplies the normal demand for petroleum products, oil companies are sometimes accused of looking with complacency on threatened conflicts between nations. The situation in Germany, which is in no important respect different from that in various other countries, shows the fallacy of this idea. If Germany felt reasonably assured of peace for the next fifteen or twenty years she would continue, almost certainly, to depend upon imports for the major part of her oil supplies. If Germany becomes a narrowing market for petroleum commodities it will be due to the fear of war and to the demands of her military leaders.

Discovering Oil From 20,000 Ft.

Amazing Accuracy Now Obtained in Mapping Geologic Structure From the Air — Contour Lines are Accurately Placed on Aerial Maps by the Stereoplanigraph.

By A. F. Maple

THE never-ending search for new oil producing areas is now becoming more intense after the slight let-down of the past few years. It even promises to become more strenuous than ever, because the increasing need for petroleum reserves is being realized at last by the industry throughout the world, and today oil fields are apparently a bit more difficult to find.

Petroleum geologists as they pursue their work are making use of every new scientific development that will assist them in the field of exploration. The tortion balance, seismograph, magnetometer, and radio are being used more and more to assist in mapping subsurface structures. Aerial photography is accepted today by all but a few as the best means by which the surface can be mapped preparatory to detailed operations on the ground.

Some geologists have developed to a remarkable degree their ability to read the ground accurately from the air or from aerial photographs. Whereas some years ago they would spend a month or more trudging through rocky canyons or hacking their way through the jungle in an effort to find promising indications of the possible presence of oil, they are now more inclined to make a reconnaissance flight over the area and sketch in the interesting and outstanding topographical features upon whatever type of a map may be at hand. From this bird's-eye view the geologist has been quick to note the general structure and drainage pattern, the conspicuous outcroppings and faultings, if any. From the information gained by flying over a wide area he is usually able to select a limited one that is particularly interesting. This selected area may be promising enough to warrant the making of an aerial survey and when the photographs are completed the geologist can study and determine many of the predominating characteristics of the territory even better than he could determine them by studying the area on foot. The photographic film, through the camera lens, is able to record many facts not apparent to the naked eye. The slight differences in soil, rock, and vegetation colorings are often accentuated on the film and call attention to contact lines or faults that might easily be missed on the ground.

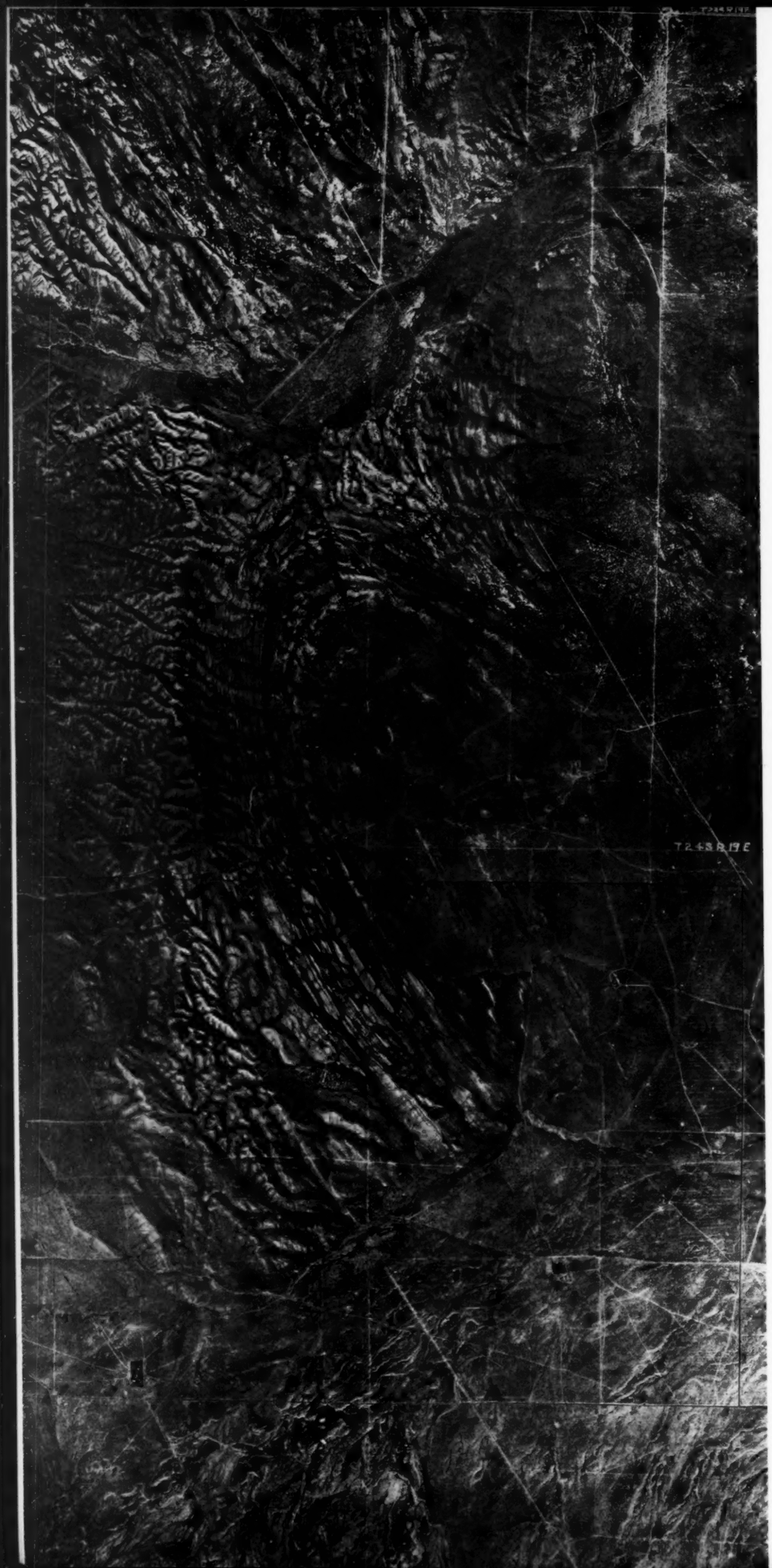
One skilled in the interpretation of the aerial photograph can see many important details and features that are not apparent to the novice. Black shadows, gray patches, and white lights are all indicative of surface conditions, but they are not always what they seem. Experience enables one, however, to make quite accurate guesses as to the character of soil, rocks, vegetation, and the works of man. After a cursory appraisal of the topographic character of the entire area, the details are best worked out under the stereoscope.

This optical instrument gives a third dimension to the picture and brings the details up in strong relief. By studying small areas through the stereoscope it is possible to estimate the depth of ravines or the height of trees or ledges. The camera flying high above the ground often records a related series of sharp details that might not otherwise be noticed. Contacts are frequently distinguished more easily from an aerial photograph than from indications on the ground and it is often possible to line up intermittent indications across a wide area, and from resulting presumptions ultimately arrive at important conclusions. The modern geologist has learned the symbolism of aerial photographs and the value of taking a large view of the area before using a pick axe and magnifying glass on surface rock and soil samples.

After gleaning all possible facts and hints from the photos, the geologist usually gets a set of prints on matte (dull) paper for use in the field. It is usually quite easy to locate one's exact position on an aerial photograph without having to use a Brunton Compass, and as information is gathered the notes can be plotted directly on the matte print.

While the geological field work is in progress, a set of contact prints is made into a mosaic map of the area photographed. It is usually what is known as a matched or uncontrolled mosaic, that is, one which is not tied in to a base survey, and therefore not entirely accurate in azimuth or in scale, but sufficiently so for exploration purposes. If it is desirable, a triangulation survey may be made later and the mosaic adjusted accordingly. A ground survey is essential, of course, if the property is to be described legally for leases and matters of record. When the matched mosaic is completed the geologist's field notes are then transferred and plotted on it in the conventional system of geologic symbols. The resulting map is far superior in valuable detail and, if of

Based on the principle of the stereoscope, this contour machine or "stereoplanigraph" develops contour maps from aerial-photo plates. Any desired degree of accuracy can be obtained. Courtesy Fairchild Aerial Surveys, Inc.



difficult terrain, is usually less expensive than one made by a topographical survey party.

For the past eight or nine years oil company geologists have been making use of aerial photographs, but many of them have not brought themselves up-to-date on the matter. Many important developments have taken place in the last few years, and it is our real purpose to acquaint you with these advances.

The technique of taking photographs has improved greatly in recent years and so have the appurtenances that go with the making of aerial maps. The new "solar-navigator" makes it possible to fly a network of triangulation accurate within about a quarter of one degree. The navigation and accurate piloting of the airplane while taking photographs for map purposes has always been a difficult problem. If the prints, when laid down for a mosaic, do not cover the desired area with approximately the correct amount of overlap in each print, the project, quite obviously, will not be entirely successful. Portions of the terrain will have to be photographed again to fill in blank spots missed originally because the pilot of the airplane was unable to fly the proper course. It has been a perplexing job to fly the successive strips accurately—a job which requires an exceptionally skillful pilot. He is called upon to keep the plane upon a course line, at a constant altitude and level. The course lines are often 100 miles or more long and flown at an altitude of 15,000 to 20,000 feet. With varying wind direction and velocities he must not stray from that line more than about a half mile. He must watch the temperature of the air outside and correct his altitude for changes in barometric pressure. The photographic-airplane pilot still has all of these things to do, but this navigating device, just recently perfected for use in mapping airplanes, takes the place of the guess work required heretofore in steering a flight course. The pilot now flies his course by watching a needle indicator on the instrument board in front of him. This needle is controlled by a galvanometer which is actuated by the combination of a sun-compass in the roof of the plane and a drift indicator suspended below it in the floor of the plane. Once the proper course is set the problem

Northern part of the South Dome of Kettleman Hills, showing bedding. Courtesy of Shell Oil Co. and Fairchild Aerial Surveys, Inc.

of varying winds and lack of visibility is solved automatically, and the pilot merely follows the indications of the needle before him and by so doing flies an accurate course.

Its use in large unsurveyed areas will be of great value. With two known starting points it is now possible to fly a system of triangulation far into the back country. This is done by taking a series of photographs at the points where each triangulation flight line crosses each other line. A triangulation net may be built up quickly in this way at very little expense. It is accurate to about one quarter of a degree.

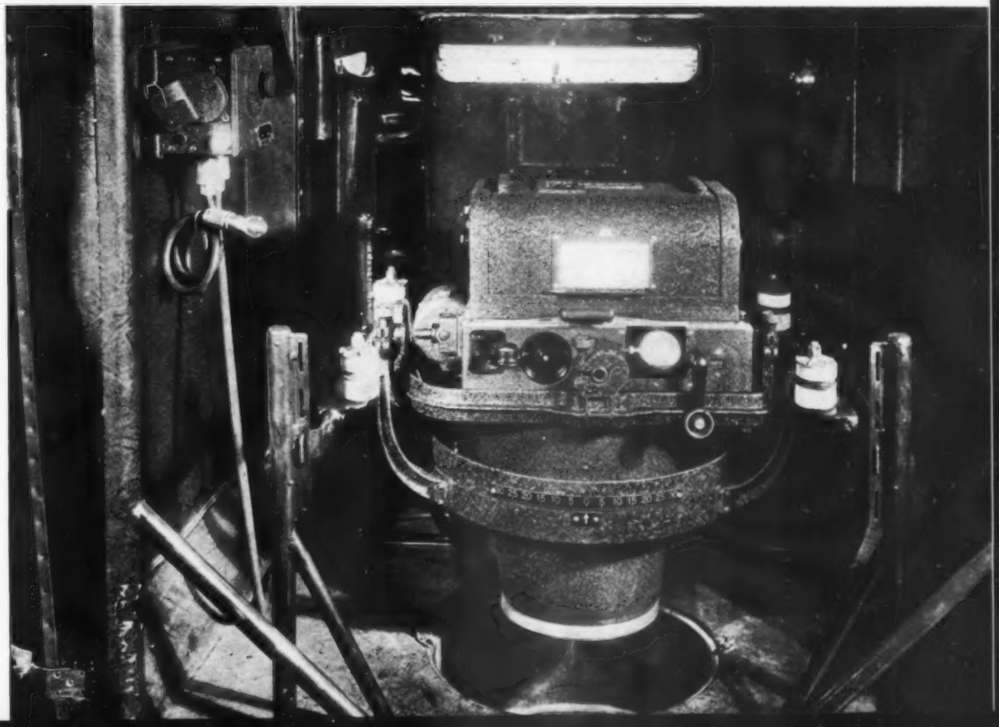
The contouring machine has been improved to a surprising degree, and it is now possible and practicable to have a topographic map made from the aerial survey mosaic rather than to send a plane-table party into the field. This precise art of making contour maps by using a camera instead of an alidade or transit is known as "photogrammetry" and although not a new development, it has been generally accepted for use only within the last few years.

The contour machine or "stereoplanigraph" is based on the principle of the stereoscope. By taking two overlapping aerial photographs having a common area taken successively as the airplane moves along, and placing them under a stereoscope, the effect of topographic relief is obtained. This third dimension is the result of one eye looking at one photo and the other looking at the second photograph.

The "stereoplanigraph" is used extensively by Fairchild Aerial Surveys and its operation is described by Leon T. Eliel of that company in this manner:

"Obviously, there are certain very definite geometrical principles which account for this phenomenon of stereoscopic vision. Your eyes follow exactly the same angular paths that two transits would follow were they placed in the position at which each picture was exposed. As the transits would have to converge on a high object, which is closer to them, so your eyes must converge to meld the two images of this high point. When your eyes converge, your brain registers that that object is closer to you. As the transits would diverge, when viewing from the two camera stations to a lower, more distant point, so your two eyes, in following the same light paths to the images on the pictures, must diverge to meld these images. This divergence of the axis of the eyes records on your brain, indicating that the object is further away. The amount of this convergence and divergence is an exact mathematical quantity.

The stream on the north side of Avery Island was probably deflected due to upward movement of salt dome; such stream peculiarities are highly suggestive to the geologist that structure is present. The aerial camera (shown below) is mounted for vertical photography. Courtesy of Edgar Tobin Aerial Surveys and Fairchild Aerial Surveys, Inc.



Ashland anticline, in Oklahoma. There is no difficulty in locating large folds from photographs such as this. Note the apparent steep dip of beds north of Ashland anticline, which is substantiated by structural contours. Courtesy Edgar Tobin Aerial Surveys

"In the stereoscopic plotting machine the two photographs are replaced in miniature as they were at exposure. The exact angle and elevation of each picture is reproduced at the small scale of the stereoscopic model. Then, while viewing the picture stereoscopically, an index or reference mark is provided, which is so mechanically articulated by the machine that it can only appear to move in a single horizontal plane. This index mark appears to float in the air, if it is out over a canyon; and it appears to bury itself in the plastic ground, providing it is deeper than the ground surface. The operator can very exactly tell when the index mark is in precise contact with the surface of the ground. By the operation of two hand wheels he causes this index mark to exactly trace off the surface of the plastic image, and, because of the fact that this mark is mechanically restrained so that it can only move in the desired horizontal plane, it is by this operation actually following a contour line, which the machine draws onto a piece of paper forming a map.

"Maps may be made by this means to any desired degree of precision. They are made at scales as large as one in. equals 20 ft., and may be made at scales as small as one in. equals two miles. Under most conditions maps may be made by this method more economically than by conventional ground methods to the same degree of accuracy.

"Of course, a certain minimum skeleton of surveyed control points on the ground is necessary for the proper preparation of a photogrammetric map. For example, a map at a scale of approximately one in. equals 1000 ft. requires a known control point for each square mile of territory."

Another development of the last year aids greatly in mapping rough terrain where elevations vary greatly. The distortion appearing in the photographs taken of precipitous country has always made the use of the aerial camera of little real value because the map made by this means was inaccurate. Now, however, it is possible to map terrain of different elevations and to assemble an accurate mosaic quickly. It is no longer necessary to match images of overlapping photographs in the new method. A mosaic of this type when controlled by a flight triangulation net, for instance, is a reasonably accurate map—and the country need not be entered on foot at all.

These recent developments open many large areas to geologic exploration at small cost compared to the former costs of sending survey parties to spend perhaps months in the wilderness building a map.

There are, of course, some types of country in which aerial photography will not be of much value to the geologist. Where the ground is covered by heavy vegetation or forests many of the important geologic details are concealed. Again, aerial maps of plains areas and prairies usually do not reveal much to the geologist because the structures are generally covered by alluvial or cretaceous soil extending over a wide area. But, on the other hand, the flying camera has recorded much of interest to the geologist in the tropical jungles of South America. At this time considerable aerial mapping and exploration is under way in Venezuela and Colombia and more is being planned.

It is a mistake to generalize on the matter of the cost of aerial mapping. Costs are of vital importance, to be sure, but one should not dismiss the idea of using aerial maps with the thought, "yes, they would be interesting to have, but they cost too much." The cost depends on the project, its location, size of area, scale desired, weather and other factors. In the past maps have cost all the way from $2.00 per square mile to as much as $50,000 per square mile, but a more normal range is from $5.00 to $50.00 per square mile. Before dismissing the matter, it is better to get an estimate from an aerial survey company and you will probably find the cost less than that of the conventional ground survey methods.

Aerial mapping has outgrown its adolescence. Within the past year it has developed to a remarkable degree and is not to be compared with what it was just a few years ago. It is now an exact and highly specialized service and is being recognized in the engineering field as an instrument of great value.

The modern tank truck, attractive in appearance, efficient in operation

Operation of a Land Fleet

Factors that Make for Profitable Operation of An Automotive Division Distilled from the Experience of the Man in Charge of One of the World's Largest Fleets.

By J. F. Winchester

General Automotive Manager
Standard Oil Co. of New Jersey

THE operation of a fleet of motor vehicles by any party takes one into a multitude of ramifications that include various problems involving engineering, ethics and psychology. Such operation, particularly the type that has to do with a major oil concern, requires a tremendous amount of detail and follow-up in order to obtain economical results. It requires a specialized organization, the type depending upon the territory, product and other particular considerations with which such a department has to cope.

Chart 1 (p. 186) gives some idea of the various services performed by the motor vehicle fleet in the transfer of oil from earth to the consumer.

Each branch of the service requires special considerations for proper selection and operation of vehicles. For instance, a manager's car for sales work might not be suitable for the producing department manager who travels over poor roads, rough country, and for long distances.

Machinery transportation for long pipeline routes is quite different from "donkeying around" a refinery plant.

The oil industry, itself, has done much in the past, and will continue to do much, in the interest of better organization and exemplary operation. Emphasis on safety, activities against detrimental legislation and general endeavor to act in the interests of all has marked the oil industry as one of the leaders in the campaign for better operation of motor vehicles.

Selection and Purchase of Equipment

THERE are various ways of purchasing equipment. One has to do with merely telling the purchasing agent how many trucks you need and what capacity. He, in turn, may listen to the claims of the various salesmen and probably will be guided in the final selection by cost alone. This method in many instances has been found to be fundamentally unsound, the reason being that in a given classification a wide selection to cover a given type of work can be found. A number of different engineering principles have been coordinated into examples such as,—the four-wheel truck, the six-wheel truck, tractors, semi-trailers and four-wheel trailers with variations in connection with traction possibilities. Also, there are the four-wheel drive, or six-wheel drive units which may be powered with different types of engines and have included within their make-up many engineering features which may be economical or expensive depending upon the type of service to which they are applied.

In addition to these outstanding features, there is an ever-changing perspective based upon design as to what is best suited for a given type of operation. Where a large group of vehicles are operated, there is no question but what an upward perspective can only be maintained through specialized activities in regard to operation and maintenance.

Some of the factors which have a bearing upon the operation of the vehicle are as follows:

1. Are you required to haul a large load a short distance, or a small load a long distance, etc.? Would several small loads a day, over a given route be preferable to one large one, or vice versa? Which truck offers the best service facilities and parts depots?
2. Operating routes may be in congested districts, or in sparsely-settled, wild country. The terrain may be level, or it may be very hilly.
3. State Laws and Regulations are constantly becoming more rigid, particularly with regard to axle load limitations.

FLOW OF REPORTS IN THE INTEREST OF
MOTOR VEHICLE GENERAL ACCOUNT & PHYSICAL OPERATION
AND PERIOD OF RECEIPT FROM PRECEDING OFFICE

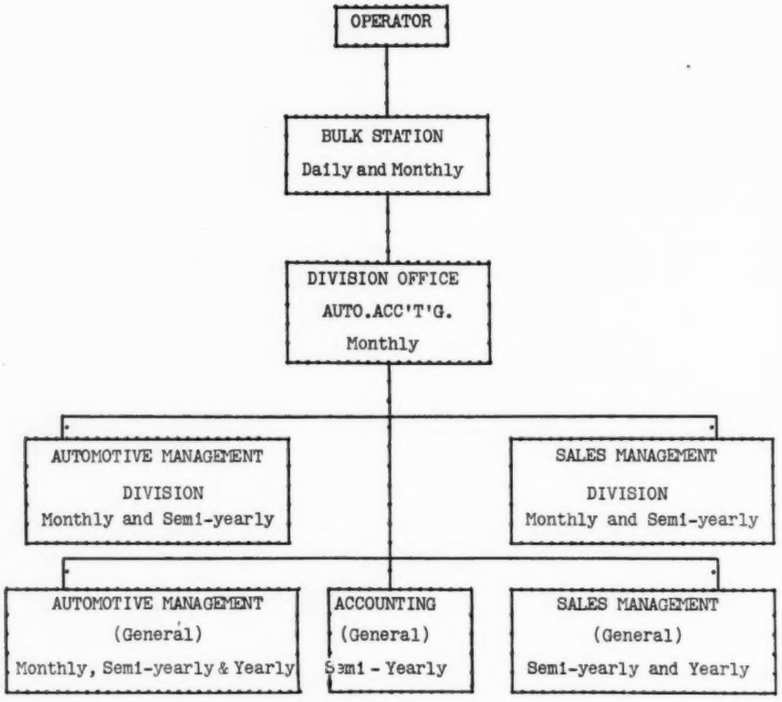


Chart 1

The question of standardization has to be studied, and while standardization can be argued for from a standpoint of making it much easier to handle the vehicles, yet, on the other hand, when a large fleet is considered, it is well not to limit the type of vehicles to any particular make, as this would eliminate a direct method of comparison between various makes. We standardize the make in a district or at a station, and try to hold a station to not more than two makes, which simplifies the service and operating problem.

Assuming that the various possibilities have been taken into consideration and it has been found feasible to make an installation, the largest load possible under existing conditions should be hauled, for the reason that operating figures will show that the unit cost, such as ton-mile, etc., is materially higher where smaller units are used. Also, from the standpoint of general operating economy, the installation of a heavy unit is preferable to a small one, as a large unit simplifies the problem of control and handling, fewer units being required.

Considerable thought should be given to the new streamlined, high-speed trucks recently made available. With such units, the fine concrete highways can be utilized to their greatest extent and congested traffic conditions can be easily met. Streamlined trucks are like large passenger cars in appearance. Therefore, they should handle more easily and more efficiently among passenger cars which are in the majority on the highway.

Moreover, it is most important to bear in mind the general good effect such equipment has on public opinion. The safety of these vehicles is very evident. Their speed will meet with favor, and their appearance is impressive. All these factors will help to lessen public resistance to truck operations, and will result in general economy and increased profit through lowered taxation, increased good-will, and advertising.

Before selecting new equipment, study the faults of equipment already in service and benefit by such experience.

The selection of passenger cars also deserves careful consideration.

Place of operation, distances to be covered, number of passengers, average speed required, and appearance all enter in. Sometimes, different makes are purchased for experimental purposes.

The paramount thought in this connection is that the purchase of passenger car equipment entails more than "how many passengers," and "what body style" requirements.

Organization, and Supervision of Personnel

HERETOFORE, we have set forth some of the various functions which have to do with the operation of the motor vehicle department. In this connection there is probably nothing more important than the selection, training and supervision of personnel. The manner and method of carrying along this work depends upon the type and kind of organization with which one is connected. As General Supervisor for a large company, I come in contact

Fleet Operation in the Oil Industry

	PRODUCING PIPE LINES REFINERY SALES Passenger Cars	Trucks
PRODUCING	Management Supervision Labor Transportation Supply Transportation Communications	Machinery Transportation Road Building Auxiliary Equipment
PIPE LINES	Management Supervision Employee Transportation	Pipe Transportation Machinery Transportation
REFINERY	Management Supervision Communications	Machinery Transportation Fire Fighters Ambulance
SALES	Management Salesmen Advertising and Sales Promotion Service Station Supervisors Inspectors Traveling Mechanics	Tank Wagons Barrel Trucks Automotive Repairs Service Station Maintenance Garage Stock Supplies

with various types of operation and find that methods differ in the various branches of our activities depending upon the branch of service. However, it is necessary in all branches of the business to have a thorough understanding as to the responsibility of each party connected with the motor vehicle.

In our sales department in which we have one of the largest fleets of vehicles, the General Automotive Supervisor through the Divisional Auto Superintendent is responsible for the selection, training and performance of the automotive personnel. We, however, frequently are assisted by specialists in various types of work such as,—sales, safety, general engineering and development of personnel, who contribute materially, from time to time, suggestions and advice that is fundamentally sound because it is based upon specialized experience.

In some localities we contract repair work out; in other localities we perform the operations in our own shops, and where we do the work in such shops, we have specially selected men as shop foremen.

In selecting this foreman to head the shop organization, one has to take into consideration the fact that in automobile work practically all branches of the mechanical arts are encountered. A man who superintends this work should be one who has been fundamentally educated to think along mechanical lines. I prefer one who has served an apprenticeship as a machinist or tool-maker, and has educated himself along engineering lines.

We have always maintained our vehicles on the principle that "a stitch in time saves nine," and know definitely that current and periodic inspection produces lower repair costs, more days in service, and is a definite contribution towards a lower accident rate.

For the purpose of maintaining current inspection, we employ a group of men whom we classify as inspectors. These men are first-class, all-round automobile mechanics. They understand the handling of men so that they can instruct and assist them.

General proficiency in the automotive mechanics is assumed. I have found that the system of "specialists" is most advisable, i.e. the transmission man, the engine man, the carburetor man, the electrician, and so on.

In some shops, a given mechanic may be required to specialize in more than one line for economy.

By operators, I mean those men who are entrusted with the handling of motor vehicles on public highways. Do we all realize the great importance and the need for careful selection, training and supervision of motor vehicle operators? Do we realize to the fullest extent what bearing this phase of operating has on final economy and profitable return? Do we realize that in sales effort (quality of product or service, notwithstanding) the motor vehicle operator is the final contact with the customer? Your profits are gained only after he has delivered the goods or service.

The abuse of the liberal privileges which the automotive industry has enjoyed in the past has reached the point where it is tending to create an ever-increasing handicap upon business in general, through restrictive legislation. This is placing a heavy hand upon operating privileges which should be preserved for all those who use the various branches of automotive transportation.

MOTOR-TRUCK CHASSIS-RECORD FORM

Order No .....
Model No. .....
Chassis No .....
Wheelbase, in .....
Back of Cab to Center of Rear Axle, in.....

Weight Distribution
Front Wheels, per cent.....
Rear Wheels, per cent.....

Chassis Weight, lb.....
Body Weight, lb.....
Payload Weight, lb.....
Gross Weight, lb .....

UNIT	DESCRIPTION
ENGINE	
Make	
Model	
Serial No.	
Number of Cylinders	
Bore and Stroke, in.	
Cylinder-Head Type	
Cylinder-Head Gasket Thickness	
Spark-Plugs, Size and Type	
Valve Stem Diameter—Inlet	
Exhaust	
Valve Guide Bushing—Inlet	
Exhaust	
Pistons, Make and Type	
Material	
Clearance at Top, in.	
Clearance at Skirt, in.	
Piston Pins Diameter, in.	
Clearance, in.	
Piston Rings, Make	
Number of Compression Rings	
Size and Clearance	
Number of Oil Rings	
Size and Clearance	
GOVERNOR	
Make and Type	
Part or Serial No.	
Setting Recommended Speed, r.p.m.	
FUEL SYSTEM	
Tank Capacity	
Over-All Dimensions, in.	
Location	
Gasoline Gage, Make and Type	
Vacuum Tank, Make and Type	
Fuel Pump, Make and Type	
Carburetor, Make	
Model and Type	
Size, in.	
Air Cleaner, Make	
Model and Type	
EXHAUST SYSTEM	
Muffler, Make and Type	
COOLING SYSTEM	
Radiator, Make and Type	
Capacity	
Radiator Shutters	
Fan Type	
Belt Type	
Water Pump Type	
OILING SYSTEM	
Pressure Gage	
Chassis Lubrication Type	
Oil Filter, Make and Type	
Rectifier, Type	
ELECTRIC SYSTEM	
Magneto, Make and Type	
Impulse Starter, Type	
Magneto Coupling, Type	

UNIT	DESCRIPTION
ELEC. SYSTEM (Concluded)	
Generator, Make and Type	
Voltage	
Cut-Out, Make and Type	
Unit with Regulator?	
Starting Motor, Make and Type	
Voltage	
Starter Switch	
Drive	
Battery, Make and Type	
Voltage-Ampere Hours	
Over-All Dimensions	
Distributor, Make and Model	
Spark Coil, Make	
Ammeter, Make	
Ignition Switch, Make	
Head-Lamps, Make and Type	
Lens, Make and Type	
Size, in.	
Stoplight, Make	
Fuses, Size	
CLUTCH	
Make and Type	
Number of Driving Discs	
Number of Driven Discs	
Release Bearing, Make	
Type and Size	
Pilot Bearing, Make	
Type and Size	
TRANSMISSION	
Make and Type	
Auxiliary Transmission	
Fitted for Power Take-Off?	
DRIVE	
Propeller Shaft, Long	
Length Over All, in.	
Universal Joints, Make	
Propeller Shaft Center Bearing	
Make and Type	
Propeller Shaft, Short	
Length Over All, in.	
Universal Joints, Make	
Sprockets, Number of Teeth	
Front	
Rear	
Drive Chains, Make and Type	
Size, in.	
Jackshaft, Assembly No.	
Gear Ratio	
CONTROL	
Steering-Gear Assembly	
Make	
Type	
FRONT AXLE	
Assembly, Part No.	
Wheels, Make and Type	
Tires, Make and Type	
Size	

UNIT	DESCRIPTION
FRONT AXLE (Concluded)	
Rim, Type	
Wheel Bearings, Make	
Inner	
Outer	
Hub Assembly, Type	
REAR AXLE	
Assembly, Part No.	
Wheels, Make and Type	
Tires, Make and Type	
Size	
Rim, Type	
Wheel Bearings, Make	
Inner	
Outer	
Hub Assembly, Type	
Differential, Type	
Differential Housing, No.	
Type	
Gear Ratio	
FRAME	
Make and Serial No.	
Special Members	
BRAKES	
Foot Brakes, Make and Type	
Hand Brakes, Make and Type	
SPRINGS	
Front, Make and Type	
Rear, Make and Type	
Helper Springs	
ODOMETER	
Hubodometer, Make and Type	
Speedometer, Make and Type	
Pinion Gear	
Swivel Joint	
Drive Gear	
Shaft	
Elbow	
Adapter	
Odometer Shaft	
Length, in.	
Driven from	
BODY	
Cab, Make and Type	
Body, Make and Type	
EQUIPMENT	
Hoist, Make and Type	
Power Take-Off	
Power Take-Off Mounting	
Tire Pump, Make	
Winch, Make and Type	
Capacity	
Driving Tower Assembly	
Shock-Absorbers, Make	
Horn	

Describe Any Unusual Features

Chart 2

Organized industry, as I see it, is playing a very valuable part in the reduction of accident through taking the most modern means of selecting and training operators. We must not lose sight of the fact that the status and duties of these men today is entirely different from those of the simple, rough days of early commerical vehicle activity. At that time, a good strong man who had some knowledge of the vehicle was selected as the best material available. If we look at the situation carefully today, it will be seen that the title of "Driver" is now a misnomer. He has become an operator. He operates the mobile end of commercial business. He, along with general salesmen, contacts the customer. This varies

considerably with the commodity being handled. Nevertheless, it holds, to a degree, in any line; for the operator is continually before the public eye and in that position can do immeasurable harm or good to the company's interests.

A short time ago I had an opportunity to travel through the Near East where I was driven by a Turkish chauffeur. This chauffeur had but little knowledge of the English language. He could, however, write in Hebrew and Arabic. My observation of this man indicated that even though his previous training had been limited, he had a definite sense of responsibility toward the company, the vehicle that he was operating, and the superiors whom he came in contact with. During the time that I was with him (about two weeks) he did everything possible to make me at ease, comfortable, and to give me a definite idea of the country through which I was traveling. On leaving, I asked him to write me a little about himself as I knew that he had fought with the Turks against the English in the World War. I quote verbatim what he says regarding himself, as it gives a definite example of how he felt towards his superior and the concern for which he was working.

He says:—

"I am the son of Adam and Eve, whom the waves of misfortune wrecked on the rocks of hard life, and broke my luck into pieces.

"Sometimes I live happily, sometimes I badly suffer. And such is my fate in this life.

"I believe that whatever is written, shall happen. I will drop the screen of forgetfulness on my past. I am the son of this hour. I work as a chauffeur to Mr. Chuter, Mr. Bampton and Mr. Griffiths, who are some of the heads of the Iraq Oil Co. and who are connected with the transportation and stores, and are of the important personalities of this enterprise. I feel a great responsibility when I drive one of them to inspect the works, in different places; and do my best to give them the most comfort and speed knowing that their presence on the work gives to other employees ambition. I like them for the good treatment and good advice they give to the workmen.

"I heard many times from the employees, that the presence of these men is like having the rust off the metal.

"This is all I can say about my autobiography, and beg of you to excuse me, if I made a mistake or overdid something."

The commercial field covers many different types of industry. There are private carriers, contract carriers, and common carriers. Activities range from delivery of oil, tea, bread, packages and milk to hauling long distance loads such as sand and gravel and various bulk-hauling. In addition there are the large bus and taxi industries.

It might be well to mention, in a general way, some of the things which come to mind in the specific selection and training of operators.

Granted that physical requirements and general characteristics peculiar to the particular job have been fulfilled, the real training begins. And it should never end as long as the man is employed.

The operator should be trained to keep his truck in good condition and attractive in appearance. Make it his responsibility. He should inspect his brakes, steering, tires, lights, horn, and windshield wiper, daily. Motor fuel, motor oil and radiator water are the other daily needs. Once a month, or on some other regular schedule, a complete inspection should be made by a mechanic. Operators should report faults and needed repairs.

Safety consciousness should be stressed at all times by suitable placards, letters of instruction and certificates for meritorious operation. Cooperative meetings can be advantageously conducted, at which court investigations are made of past accidents, and ideas are exchanged between the management and the employees.

Score-sheets showing accident averages of each operator, and each division have worked well.

Bonuses and rewards for good driving have their merits. Some companies feel they are indispensable, while others feel that the men's regular salary and continued employment require high quality performance.

So far we have seen what the problem of selecting and training of an operator requires in a general way. It may be well to mention now some of the detailed information required in various types of operation.

The oil man must be acquainted with metering and pumping equipment, automatic shut-off valves, fire-hazards, local ordinances and a general mechanical knowledge of all the mechanisms on his truck. A mistake on his part may mean costly damage to the truck or a serious fire. In addition, he must be a salesman, diplomat and an expert operator.

In general, we may say that the applicant for the position of motor vehicle operator should be selected and trained as follows:—

1. He should be sound of body and mind, of middle age—not too young or too old.
2. He should pass physical and road tests. Psychological tests are unproven and therefore questionable at the present time.
3. He should be tested and instructed on all safety rules—of road, local ordinances and company.
4. He should be familiarized with the mechanical features of the vehicles he is expected to operate, their maintenance and repair.
5. He should be familiarized with his load—its selling points, its distribution and precautions.
6. He should be imbued with the idea of efficiency, economy, courtesy and safety at all times.
7. Give him ample opportunity to keep pace with developments, an opportunity to advance and to improve steadily.
8. He should be encouraged, assured and assisted by the management, unceasingly.
9. He should realize the cost of operation, the meaning of an accident and the necessity of always trying to do the right thing.
10. He should be commended when he does right, and counseled with when he does wrong. Let him feel there is cooperation and a universal effort for the common good of the company.

The Standard Oil Company of New Jersey, through its ESSO Marketers, operates one of the largest fleets of motor vehicles in the world and endeavors, unceasingly, to promote management-employee felicity, understanding and collective bargaining. Collective bargaining is an excellent summary of the company attitude. It is a healthy state of affairs. The humblest driving position is bound to carry with it some feeling of responsibility and duty to the general company welfare.

Within a year's time after a man is accepted as an operator in the sale of ESSO Products, he becomes eligible for various benefits such as:—sick, accident, death compensations, medical attention, stock participation, etc. There is the assurance of a pension through the Annuity Plan. There is the "collective bargaining" scheme—joint meetings, Coin-Your-Ideas Plan, educational programs, employee-representation and Industrial Relations Department. It is interesting to note that the late NRA Code prescribed such bargaining. The Standard Oil Company of New Jersey has been practicing it successfully since 1918.

The net result of following such a method is exemplified in the Standard Oil Company where 52 percent of the personnel have had 10 or more years of service and many 40–50 years service before retiring.

Such a record makes an all-round, highly-trained and accident conscious organization that should, in the established order of affairs, protect the general interests of all in the safe and sane use of the highways.

Vehicle Maintenance

HAVING the proper equipment and men, the problem of operation devolves into one of punctual and exact main-

tenance. By maintenance is meant—regular inspection, repair or replacements when required, adjustments and lubrication.

No vehicle should be installed and left in the hands of the operator without some provision being made for a periodic mechanical inspection. Inspection is the means of taking care of minor adjustments the necessity for which arise from the constant vibration and natural wear to which any machine is subjected. It provides a means for taking proper advance precautions and eliminates the possibility of minor maladjustments becoming worse and eventually resulting in major repairs.

Besides being responsible for the mechanical condition of the truck, our inspector has to examine all men who are employed as operators for general proficiency. He is held responsible for any neglect which may result in our having a vehicle go on the road which presents other than a first-class appearance, and he reports any irregularities.

The amount of territory he has to cover must also be considered, for it is obvious that a man can take care of a much larger number of vehicles operating from a central garage than one who has to visit a number of plants or way-stations.

Repairs and Adjustments

IT HAS been proved, repeatedly, by individuals, fleet owners and others that systematic, thorough lubrication with quality lubricants will reduce the repair bill, and will lengthen the life of the vehicle. Performance and efficiency will be improved. Lost time will be avoided. Greater economy must result.

Use only the best lubricants, and the correct ones for each point of friction. It pays. Provide suitable equipment for administering this lubricant. It is not sufficient simply to apply lubricant. It must reach the entire frictional area. Sometimes more expensive equipment is faster and easier to handle, and will save money, in the long run. Provide your men with charts for their guidance. Follow a periodic system for this is the best way to attend to regular lubrication without slip-up. Watch for seasonal changes which especially affect motor oil, and transmission and differential lubricants. Do not save a few cents on lubricants for these three latter points by lengthening the drain periods. The slight saving in cost of oil is offset, a hundred-fold, by possible increased frictional drag, and wear due to accumulated contamination. Thin, diluted, dirty oil cannot lubricate properly; nor can too heavy an oil give you satisfactory service in the winter.

The execution of repairs and adjustments depends upon the distribution of vehicles. Wherever the volume of work warrants it, a central repair shop is preferable. With such a shop you can afford specialists in each line, large and complete stocks of replacement parts, and more economical repair costs will result.

Where vehicles are more thinly scattered, small shops may be maintained, or better still, the Traveling Mechanic system can be utilized.

In our organization, outfits are brought in for repairs during off seasons, or are replaced by reserve equipment, which is held for that particular purpose. Every effort is made to plan the movement into the shop so that the outfit will receive prompt attention. The progress of the work is recorded by a weekly shop report. From this we can check the various shop activities.

To obtain the most economical results, it is best to adopt the unit repair basis. This provides for the carrying of a number of complete units which can be readily substituted for the worn parts, and the worn parts can be undergoing repairs after the chassis is in the paint shop or on the road.

The shops are divided into departments, such as chassis, motor, gear, box, rear axles, electrical, overhaul and a competent specialist is engaged for these respective duties. As a department grows, the old employee should be worked into a position of working foreman. This training should fit him to assume greater responsibilities. I find that more accurate and economical results are obtained under this method than by permitting a man to do all-round work, and, besides, through this system it is possible to detect the source of poor workmanship or failures.

Inspection is provided in each department through the activities of the foreman and final inspection of the complete job is provided for by a man who is entirely responsible to the superintendent alone for the passing out of work.

Necessarily in an organization of this kind emergency service has to be provided. This is done by carrying a stock of parts at the main repair shop, and in small quantities at strategically located points. At the main station this stock room provides for the shop needs, which facilitates repairs.

To provide proper service it is necessary that correct mechanical information be kept on file, and changes in the mechanical condition of a vehicle kept up to date. We provide for this by having a complete set of specification sheets, furnished by the vehicle manufacturer, which is filed with a standard mechanical information sheet. If these records are properly maintained, the service man has a ready reference for each vehicle, which will remove a great possibility of incorrect parts being supplied. (See Chart No. 2 Motor Truck Chassis Record Form.)

If one will review the rapid advances which have been made in automotive design within the last few years and the changes which have taken place in highway construction, as well as those pertaining to distribution of products, it can be seen that there is ample need for continual review of the many pertinent factors. Only by such review may one keep abreast of the times.

The comparatively rapid evolution of the tank truck pictured above invites the thought: How will gasoline deliveries be made ten years hence?

110,000 Trucks Serve U. S. Oil Industry

The Truck, Born of Petroleum, Has Become An Essential Element of the Oil Industry's Development—48,000 Communities in U. S. Not Reached by Rail.

By Robert F. Black.

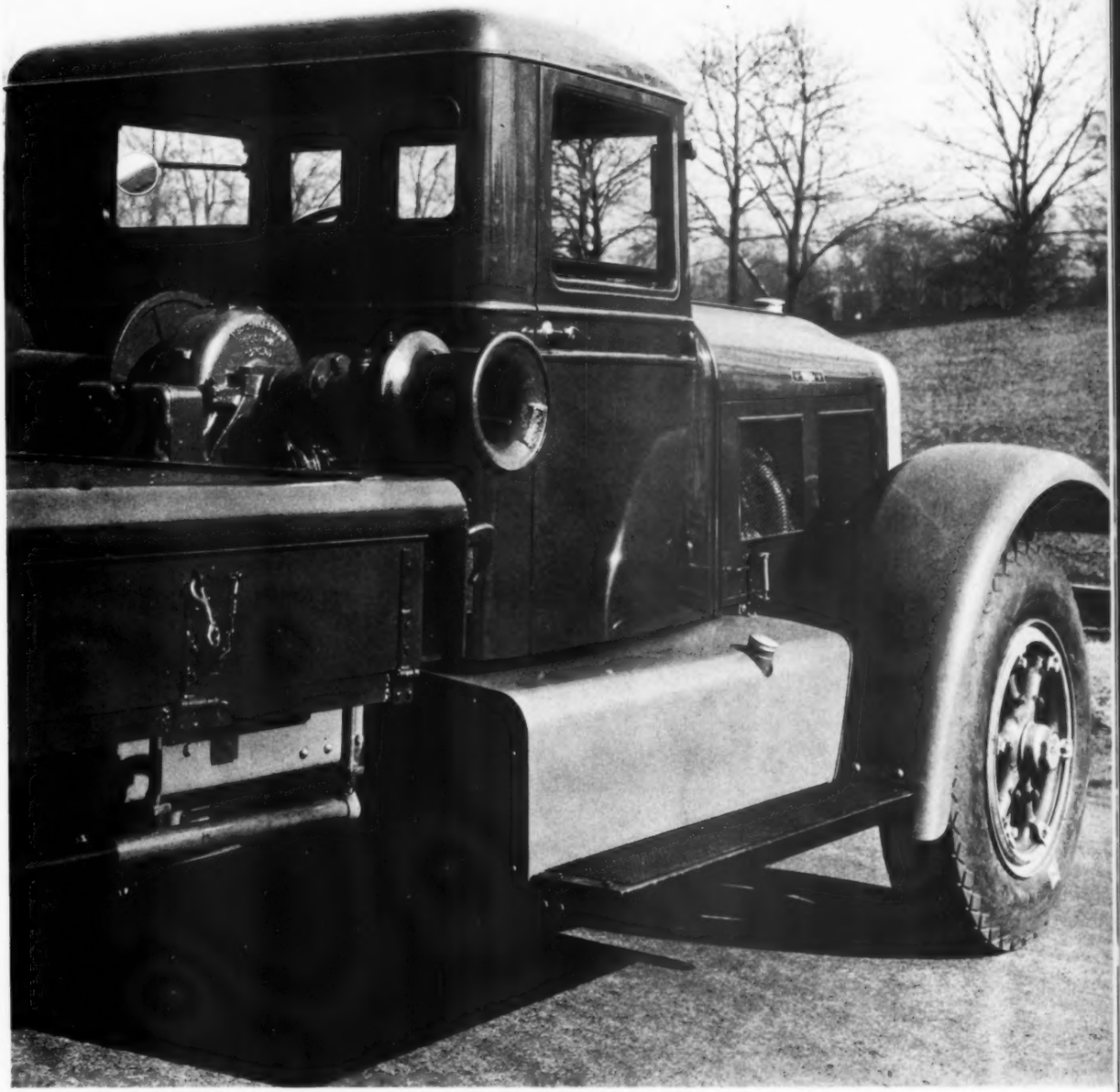
President, The White Motor Co.

A QUARTER of a century ago, when the first sale of a motor truck was made to an oil company, the commercial gasoline vehicle was just getting out of the experimental stage. It ran on oil and the increasingly important by-product, gasoline. In many other industries with less important work to do it was rapidly displacing the horse and wagon. Petroleum, however, was still depending on horse drawn drays for its heavy work, and most of its deliveries were being made in cans carried on light wagons developed for the era of the oil lamp.

Since that time the truck, born of petroleum, has become an essential element of the industry's development. Oil was a lusty infant of fifty years when the first truck went into its service. Men marvelled at the rapidity of the oil industry's growth from nothing to a total investment of about $2,000,000,000 in the first 50 years. In half the time, since then, the industry has expanded six times as rapidly. It represents now more than $12,000,000,000 of invested capital. Still growing, it dictates through trucks, busses and passenger automobiles the economics of the nation, touching at some point every other industry, affecting the lives of millions.

If that sounds far fetched, consider the facts. According to studies by the Automobile Manufacturers Association of census figures, there are no less than 48,000 communities in the United States not reached by rail. Their number is important, but not nearly so much so as their type. In other countries such places are isolated hamlets, self sufficient as to bare necessities, having little contact with the world outside. In the United States, however, the great majority are relatively new and high type residential centers, in sections that would be inaccessible without the trinity of petroleum, car, and truck.

They are suburban communities, built



Left: Trucks in their native element—a 5-ton White truck hauling drilling equipment in the Oklahoma City field, and (left below) a loading rack in Cuba, showing a White tractor-trailer model.

Right: A White model 643 used in the oil industry in Venezuela.

in the desirable hill sections at ever increasing distances from the larger centers of population. To keep them going it is necessary to maintain thousands of service stations at convenient intervals, also beyond the reach of the railways. Pipelines to these stations would be prohibitive in cost. If we had to supply them with horse drawn vehicles the resulting congestion would break down even our boasted modern highway system. The time element alone, without the transportation system made possible by petroleum, would make these communities uninhabitable.

A similar picture is available in industry. At a steadily increasing pace for the last fifteen years we have been moving plants and factories back into the country, nearer to sources of labor and the supplies of raw materials. The transmission of electrical energy over long distances contributed to this decentralization as it did to that of housing, but it could not have been done with that alone. Flexibility of transport was essential, and petroleum supplied the power that could carry itself almost anywhere.

In the other direction—the movement toward the city—an even greater transformation has taken place.

In nineteen major markets of the United States, for example, it is shown by reports of the Federal Coordinator of Transportation that 98 percent of the milk movement from farm to city is by motor truck. Similarly, in 1934 trucks hauled 48 percent of all live stock and 64 percent of all fresh fruits and vegetables. Oil can claim credit for taking many of the latter items out of the luxury class and making them available at reasonable prices for the tables of every man.

It is within the industry itself, however, that the romance of the motor truck in petroleum reaches its full development. The general public thinks of the oil truck only as a tanker. Important as that

unit is, in the never ending service of oil, the records indicate that an even more essential service performed by the truck is that which takes place behind the lines. The first truck sold to the industry was used for general hauling at a plant in Pennsylvania. General hauling since then has become specialized to an extent not approached by any other industry.

Motor trucks, today, are essential units in all new oil drilling operations, in the building of pipelines to take the crude to the refineries, in the final wholesale and retail distributing operations, in the scientific surveys that lead to the location of oil, and in countless other intermediate functions. The speeding up of these preliminary jobs has probably had as much to do with the huge enlargement of known oil reserves, and with their rapid development as any other single factor.

A familiar sight on highways today. 1500-gallon tank truck, built by White, delivering gasoline in the St. Louis district.

For a time this was true only in the United States, but now the truck is pushing its streamlined nose into every corner of the world. Motor vehicles have been playing their part, of course, in all great engineering enterprises, such as the building of railways, highways and bridges. Not any of these operations, however, is conducted in spots as inaccessible to begin with as oil. They are laid out to suit conditions and the amount of funds available. Oil is found where it is. To get it man must go there with heavy and expensive equipment.

Oil follows man in the distribution end, in other words, but in the production end man follows oil. It leads him into mountains, plains and marshes—and in most instances there is no time for road building. The trucks must go in over whatever way they can find with lumber, boilers, engines, casing and drills. Not only that, but they must go in fast. They must operate in all kinds of weather, carrying loads that would stop a twenty mule team in its tracks.

The long Y shaped pipeline that now carries out 85,000 barrels of crude a day through Mesopotamia from Iraq to the Mediterranean furnished one of the most brilliant modern examples of what the motor truck means to the oil industry. Five great cooperating groups are interested in the line, which was built under conditions of almost incredible hardship at the rate of a mile a day. The line is double, and is 600 miles long. To complete it more than 100,000 tons of steel pipe had to be hauled in. Before that was started it was necessary to dig the trench. Trucks pulled the trenching machines. Trucks carried in the laborers, the welders, and their equipment. At one point they had to cross a two mile stretch of lava, with points as sharp as glass. There was no time at the outset to do anything about this except to put on new tires, but after the work got well under way a road roller was brought in—on a truck—to crush the lava into a roadbed.

The temperature at times along the route of this line ran to 120 deg. in the shade. Traffic over the rough terrain was so difficult that too much time was required to carry ailing workers back to the seaboard. Traveling dental trucks were sent out into the field, and others equipped with medical supplies, doctors and nurses. In a thousand miles of operation air filters on the carburetors often gathered as much as two pounds of dirt. To compete with that sort of difficulty in operation traveling repair shops were necessary. They moved on trucks.

The oil industry may justly claim credit for another contribution through this type of service. In the nature of the work that precedes the flow of the black gold through the pipelines, nearly every job is in some respects an emergency operation. Since there is no precedent, the oil field becomes the finest testing ground in the world. Truck builders who can fit their product to meet its demand find little difficulty thereafter in meeting the requirements of other industries.

The operation of the truck at the other end of petroleum—the delivery of its finished major product—supplies still another chapter in the economics of distribution. The public is familiar with some phases of this, chiefly the service of the tank truck in supplying retail gasoline stations. What it does not see is the intricate system of truck and trailer operation by which gasoline is carried from the refineries or from railway tank cars to wholesale storage stations. These operations began in such large centers of population as the New York metropolitan area, and they have been extended since to many other cities and even to inter-city hauls. The savings in time pays for the trucks.

Recent estimates show that there are now no less than 110,000 commercial motor vehicles in the service of the oil industry. With the steady increase of decentralization of both homes and manufacturing, and with the rapid growth of oil as fuel for homes, the dependence of the industry on the truck is increasing. Truck manufacturers have shown that they are prepared to meet this demand with fast modern equipment, stream-lined and safe.

A Survey of Motor Truck Operating Costs

Adaptability a Controlling Characteristic of the Truck Makes Possible the Increasing Diversification of Its Uses.

By Warner Tufts

THE one hundred and fifty ton gross load of the special haulage lorry engaged in the movement of heavy machinery, structural steel members, etc., and the eight hundred pound cycle car performing its light delivery service are, by their contrast, singularly emblematic of the most impressive characteristic of commercial motor vehicle transportation in the United States. They symbolize a variety which occurs not only in the physical size and performance of the vehicle but also in the environment to which it may be adapted and the transportation needs which it can be made to serve. They likewise point a warning to hasty generalizations as to operating costs or relative transportation economies.

The problem of motor truck operating costs is complicated by this variety in six distinct ways, and though the study referred to later in this discussion attempts to throw some light on one of them, they must all be subjected to measurement before a thoroughly adequate solution is attained.

The first of these complicating influences is the element of time, in a historical sense, with its effect on prices, its contribution to the physical improvement of roadway and vehicle, and its ever accumulating gifts to the sum of knowledge concerning efficiency in operation. The cost curves presented herein relate to 1932; it is important to know the way in which 1935 costs are likely to differ. The average life of all trucks in use is approximately nine years, and the 1932 sample therefore contains trucks of various ages; it is important to understand the differences in operating costs between a truck manufactured in 1922, for example, and one produced in 1931. And it is also important to recognize the functional changes that have taken place and are taking place in the truck itself and in truck transportation.

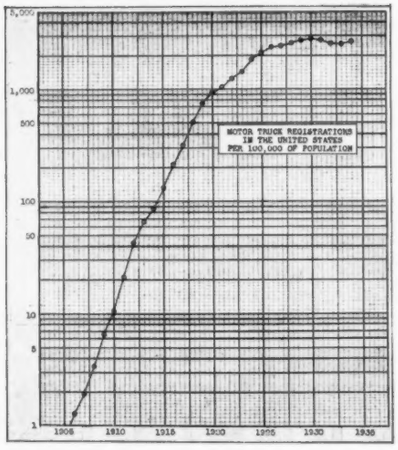
The truck growth curve presents a graphic history of the numerical increase of the truck in the United States in relation to population. Curiously the last decade, which has witnessed a limit in this relative growth, has been the period of greatest diversification in the uses to which the truck has been adjusted. This has been brought about in part by an approaching saturation in its older function of merely supplanting the wagon or dray; in part by improved highways which have extended its radius of operation; in a very large part by the changes occurring in habits of production and distribution; but perhaps mostly by the cumulative benefits of automotive engineering and tire manufacturing experience and the increased pressure on the ingenuity of manufacturers caused by the declining rate itself. It is quite likely that an increasing annual mileage per vehicle, and particularly an increasing trailer use, will permit the growth of truck traffic in terms of ton-miles to continue for some time without an accompanying increase in registrations.

Prices have been declining during the period. According to manufacturers' data the wholesale value of all trucks produced in the United States and Canada in 1920 was $946 per ton of capacity, for 1925 this figure dropped to $567, for 1930 it dropped to $413, and for 1934 it was $335. Considering trailer use in connection with trucks of recent manufacture, the figures would further decline importantly because of the smaller investment per ton of capacity necessitated by trailers. Retail gasoline prices, including the tax, were 30 cents per gallon in 1920, 22 cents in 1925, 20 cents in 1930 and 18 cents in 1933. And the index of retail tire and tube prices as of July fell from 100 in 1920 to 60 in 1925, 34 in 1930 and 30 in 1933. Accompanying these price changes has been definite improvement in roadway surfaces, in vehicle design and in tire and fuel performance which actually enhance the importance of price trends. Such trends are of course reflected in operating costs reports, perhaps quite representative of which is the large New England for hire operator whose costs were 38 cents per vehicle mile in 1917, 37 cents in 1922, 33 cents in 1927 and 28 cents in 1931.

The second source of variety in the problem of truck costs is the element of place, in a geographical sense. It is present in most cost problems and needs no elaboration, other than to state that in a continental area of the size of the United States, wage, tax and price conditions vary materially, and costs should therefore be equated to remove such influences, in the complete study. There are often equalizing factors, however, as

A DECLINING growth rate of truck registrations has been accompanied by an increasing diversification of truck use, according to Warner Tufts, member of the research staff, Federal Coordinator of transportation. The greatest development in truck transportation has taken place in the period since the war, during which many forces have been working toward greater specialization in transportation, increased frequency of service and reduction of average shipment size. Truck costs are influenced by six important variables. Gross weight is dominant among the causes of cost variation throughout the range of truck operation.

The 1932 data presented are from the truck costs investigation of the Federal Coordinator of Transportation, made by the author. The general discussion herein, however, represents the author's personal views.



Motor truck registrations in the U. S. per 100,000 population.

for instance in certain regions of the South where wages are low, while fuel and materials prices are high and road surfaces are relatively inferior.

A third cause of variation is the human factor, not so much with respect to management or the repair shop, as with respect to the man behind the wheel. Two vehicles of identical characteristics, travelling the same road with the same load, may have entirely different operating costs simply because of driver differences. Nor is the question always one of driver selection. The driver of a truck is usually the company representative, with important influence on customer reaction, and frequently the business value of a hard driver will far outweigh his expense account of tire wear, brake maintenance and engine depreciation.

In a sufficiently penetrating analysis of truck costs, the measurement of this human element should offer little difficulty once the other five variables are analyzed. In an investigation of national experience an average human factor would appear, while in the case of a particular fleet, the dollars and cents contribution of each driver to operating costs could be computed, perhaps absolutely, but certainly in terms relative to the fleet average.

A fourth complicating variable would seem to be present because of differences in organization size. Purchasing power, specialization through departments, routine inspection and mass production methods in maintenance should reasonably promote economy in the large fleet. On the other hand, certain characteristics of truck transportation point to opposing influences.

In the case of the small private operator, there is a distinct tendency for the truck to share in costs of personnel and space which would be incurred were there no truck operation. This tendency diminishes with the increase in fleet size until exclusive facilities, personnel and overhead must be provided in each department in order to conduct the operation. The joint cost tendency holds true, but in a different sense, for the small for hire trucking concern, where the single employee may frequently perform various functions which in the larger organization must be assigned to specialized departments. The coordination of activity made possible through first hand familiarity on the part of the personnel with all phases of the operation is also an important factor in cost reduction. It may carry much greater importance, however, in customer contact and net revenues.

The greatest development in truck transportation has taken place since the war, the reconstruction period of which destroyed the inventory, enhanced the importance of consumer service, accelerated style changes, introduced hand-to-mouth buying, increased branch plants, caused decentralization of industries and otherwise promoted the many forces working toward greater specialization in transportation, increased frequency of service and reduction of average shipment size.

The truck appears to be suited to such requirements. Part of its lack of inertia lies in its availability for low cost innovation and experiment. Vehicle life in relation to investment is very brief. Five years could change the entire character of highway transportation without serious loss resulting. The truck can meet emergencies in still another way. Its fixed expense is relatively small in comparison with its variable expense, the ratio being but one third to one half that of rail service.

These qualities, coupled with the fact that the required investment is sufficiently low to permit ownership by the individual entrepreneur, have favored the growth of small scale operations. Approximately three quarters of all trucks in the United States are used by concerns who own but one truck. Barely a hundred fleets of more than a hundred vehicles and a third as many of more than a thousand are in operation.

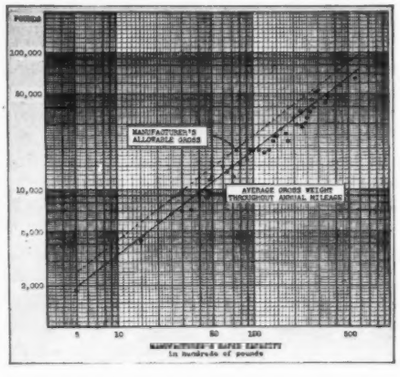
The greatest part of these one-truck owners are commercial enterprises or business houses—close to 85 percent of all trucks registered are not for hire—to whom records of truck cost are unimportant in relation to the value of prompt delivery and the convenience afforded by a small unit transportation facility.

With factors such as these surrounding the growth and development of the truck it seems most reasonable that, for the present at least, the for hire truck must look to the private operator as its true competitor, and must retain the flexibility and offer an approximation of the customer contact afforded by the small scale private service. If it loses these characteristics through the systematization and inflexible routine and impersonal formality so frequently accompanying large scale organization, it departs from a function to which it is peculiarly adapted and enters more definitely into competition with the railroad. This is not intended to imply that large operations must necessarily follow such a course, because it would seem quite plausible to retain small scale advantages in the large organization through a unit system with decentralized authority.

The effects of organization size on operating costs should be carefully considered, but its effects on revenue should be of equally important concern in the analysis.

The fifth element working toward variety in costs is really a whole group of elements representing the physical conditions surrounding the operation of a given vehicle, and the physical requirements made of that vehicle in terms of speed, annual mileage and total duration of service. It is well known that road surface grade and vehicle speed conditions affect operating costs to measurable degrees. It is not so well known that fifteen or twenty normal stops per mile may be sufficient to double the gasoline consumption over the non-stop run, and that the same reaction occurs in depreciation and brake and tire wear. In retail store delivery service the traffic conditions that permit one hundred miles of operation per day have been found to result in a tire-mileage life one hundred and fifty percent greater than results from those

Manufacturer's rated capacity in hundreds of pounds.



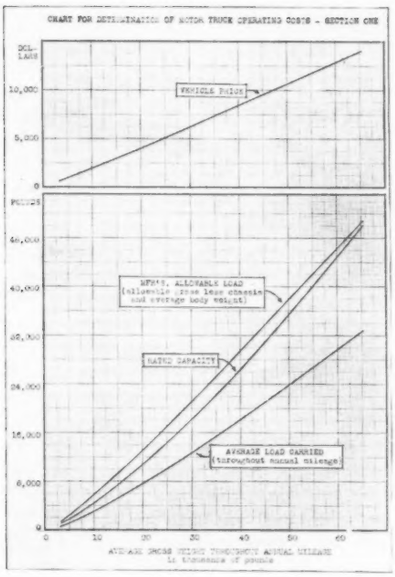
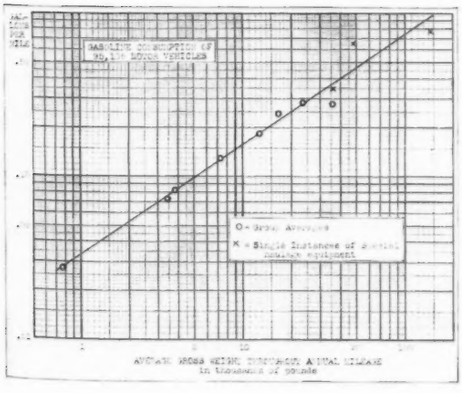


CHART FOR DETERMINATION OF MOTOR TRUCK OPERATING COSTS - SECTION ONE
VEHICLE PRICE
RATED CAPACITY
AVERAGE LOAD CARRIED
(throughout annual mileage)

Determining motor truck operating costs — section one.

traffic conditions permitting only fifty miles of operation per day. An increase in atmospheric temperature one hundred percent above forty-five degrees Fahrenheit has been found to increase tire tread wear by two hundred and fifty percent, and such experimental results have been substantiated by annual records of temperature versus vehicle miles per flat. Improper inflation of the tire will affect fuel consumption as well as tire wear in a measurable way. Similar illustrations could be extended into most items of expense, but so many of these physical elements depend on an economic adjustment of the vehicle to the task, that it may be well to cover them more or less jointly with the sixth cause of variety in

Gasoline consumption of 95,105 motor vehicles.



truck operating costs. It should be said in passing that the essential difference between the costs of private and for hire operations lies in the element of annual mileage.

This final way in which variety enters the problem has to do with the physical differences in the vehicle itself and the load that it is required to haul. There are forces at work to eliminate the differential resulting from all other causes where such leveling has an advantage, but there is little hope of materially harmonizing the costs of the one ton gross load with those of the twenty ton gross load.

With mass production methods, a more or less free interchange of patents, and especially with keen competition between manufacturers, the American automotive industry follows closely certain common standards in machinery and materials incorporated in a motor vehicle designed for a specific performance. It is an unfortunate consequence of the wide range of required performance, however, that for purposes of simplified advertising, selling and licensing classification, motor trucks are categoried according to a factory rated carrying capacity, in which categories they remain whether operating in service over rough mountainous roads or on the level concrete of the coastal plain, whether hauling carefully packed furniture or subjected to the loading impact of a steam shovel in the excavation pit, whether traveling as a single unit or in combination with the added burden of a trailer of like capacity. And the average conditions assumed in the capacity rating are so frequently inapplicable to the particular transportation task that the solution of the problem in the majority of cases becomes distinctly an engineering affair.

When the appropriate selection has been made from a particular make of truck, however, it will agree within fairly close specification limits with the appropriate selection from any other make of truck, though it may not agree at all in terms of rated capacity. This is so because rated capacity is a rough and more or less arbitrary generalization, while performance capacity is based on horse power, torque, gear ratio, wheel diameter and engine speeds and efficiency and is consequently closely determinable.

Performance capacity also implies an economic element of time, which in physical terms is represented by stamina or durability. Two trucks may be able to do the same work equally well, but one will do it over a greater mileage than the other. This does not contradict the statement that manufacturing practice results in vehicle standardization for a

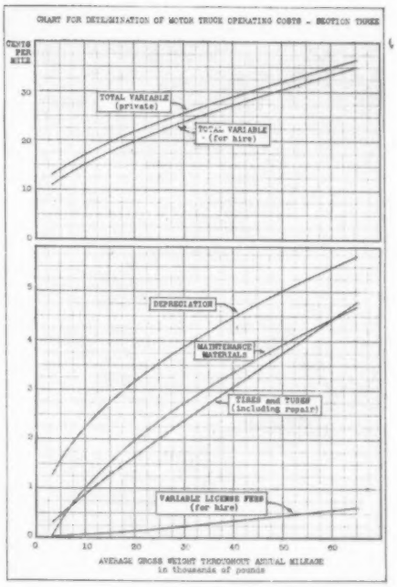


CHART FOR DETERMINATION OF MOTOR TRUCK OPERATING COSTS - SECTION THREE
TOTAL VARIABLE (private)
TOTAL VARIABLE - (for hire)
DEPRECIATION
MAINTENANCE MATERIALS
TIRES and TUBES (including repair)
VARIABLE LICENSE FEES (for hire)

Determining motor truck operating costs — section three.

specific performance, because vehicle life is a part of performance capacity.

Thus, in brief, truck manufacturers build into their product according to closely comparable standards, (1) ability to pull, which means ability to accelerate under specified loads and to climb specified grades, (2) ability to pull at the desired speed, and (3) ability to do this under particular road and vehicle maintenance conditions over a desired period of time.

A maximum economy is attained in the use of the vehicle when the performance required of it in all three of these particulars corresponds to the performance for which it was designed. Increased operating requirements in any one of the three will result in reduced performance in one or both of the others. On the other hand, unnecessary over-provision of performance capacity in any one of the particulars will interfere with the attainment of a maximum economy in operation. Unnecessary power means unnecessary investment and interest and fuel consumption, though relative savings may be made in durability.

Unnecessary stamina or durability may, however, also defeat a maximum economy by extending the useful life of the vehicle too far beyond the point where obsolescense requires a change. Trucks are steadily becoming cheaper to own and cheaper to operate. Improvement in design and features of operating convenience are constantly appearing in the newer models. The point of maximum

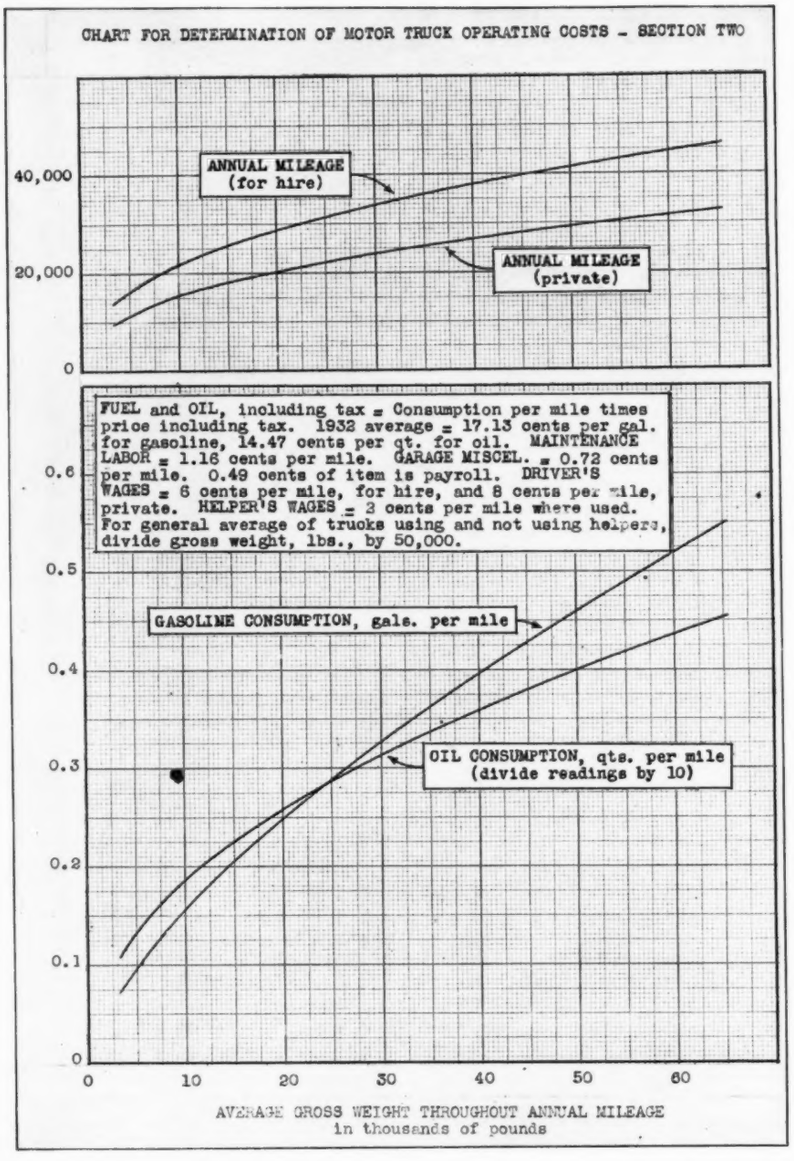


CHART FOR DETERMINATION OF MOTOR TRUCK OPERATING COSTS - SECTION TWO
ANNUAL MILEAGE (for hire)
ANNUAL MILEAGE (private)
40,000
20,000
0
FUEL and OIL, including tax = Consumption per mile times price including tax. 1932 average = 17.13 cents per gal. for gasoline, 14.47 cents per qt. for oil. MAINTENANCE LABOR = 1.16 cents per mile. GARAGE MISCEL. = 0.72 cents per mile. 0.49 cents of item is payroll. DRIVER'S WAGES = 6 cents per mile, for hire, and 8 cents per mile, private. HELPER'S WAGES = 3 cents per mile where used. For general average of trucks using and not using helpers, divide gross weight, lbs., by 50,000.
GASOLINE CONSUMPTION, gals. per mile
OIL CONSUMPTION, qts. per mile (divide readings by 10)
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
AVERAGE GROSS WEIGHT THROUGHOUT ANNUAL MILEAGE
in thousands of pounds

Determining motor truck operating costs — section two.

economy is reached only when the operating costs of the new vehicle would not be less than the costs of continuing the use of the old, and this may have nothing to do with the serviceable life remaining in the old.

Confronted with these factors, the manufacturers find it difficult to agree on generalized rated capacities. The problem is further complicated by the variety in body types, which in reality make up a part of the truck load and more than half of which are of special design and suited to the needs of the particular operation. The manufacturers do, however, provide a measure which should be observed. It is the maximum allowable gross load rating given to the chassis. With the weight of the fully equipped chassis and body subtracted, a figure is available which represents all the payload that the chassis members and engine parts are designed to accommodate. When this figure is materially exceeded in loading, not only will costs increase and the life of the vehicle be unduly shortened, but there is introduced an actual danger of mechanical failure, which in instances, may mean serious accident. The following figures represent averages:

Rated capacity, lbs.	2,000	4,000	10,000	20,000
Mfr's. payload allowance, lbs.	2,786	5,398	12,474	23,031
Resulting overload allowance, percent	39.3	35.0	24.7	15.2

It will be observed that the average allowed overload above the rated capacity is relatively greater for the small truck than for the large. Smaller total investment and wider use result in greater carelessness in the handling of these vehicles and the safety margin is therefore increased.

One other characteristic difference between the small truck and the large should be cited. The overwhelmingly greater number of light capacity trucks manufactured and the broad utilization, in this group, of passenger car engines and accessories gives them a basic economic advantage. Nevertheless, in spite of this, the bigger the truck the less it costs per ton of load allowance both to purchase and to operate. Averages for private trucks, taken from the Federal Coordinator's investigation of 1932 motor truck operating costs, will illustrate. Operating costs include overhead:

Rated capacity, lbs.	2,000	4,000	10,000	20,000
Price per ton allowed cap., dollars	768	670	622	584
Cost per ton mile, allowed cap., cents	14.2	8.3	4.5	2.6

THE foregoing rather general discussion of the subject serves mainly to outline the problem. It may also provide the necessary breadth of interpretation, without which any compilation of truck cost data not accounting for the influence of all variables is likely to be seriously misleading. It is the essential foreword to the cost and performance charts presented herein.

Under the direction of Joseph B. Eastman, Federal Coordinator of Transportation, an investigation of truck costs in comparison with other transportation costs was made, the detailed results of which appear in the Freight Traffic Report of his Section of Transportation Service. The study was based on questionnaire replies from 503 motor truck operators scattered over 40 states and the District of Columbia. These furnished unit cost data for the year 1932 on approximately 18,500 individual vehicles or groups of vehicles of like rated capacity, ranging from the small cycle car delivery unit having an average gross weight throughout its annual mileage of 1,050 pounds to the trailer combination with a gross of almost 65,000 pounds. They were operated individually and in fleets comprising up to 3,761 vehicles, and though the sample was heavily dominated by fleet conditions, there was no evidence that the costs of the small operator dif-

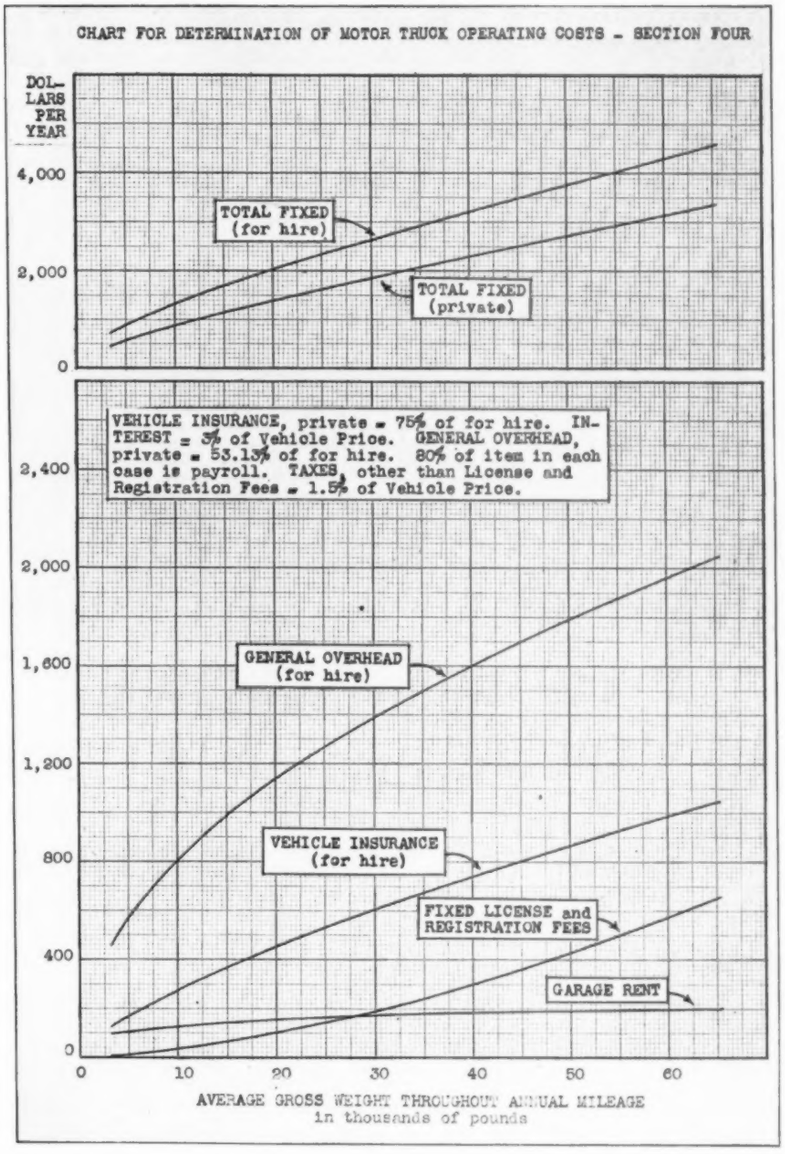
fer in a consistent way from those of the large. These replies were supplemented by recourse to other investigations and source data, and the curves of costs or performance were carefully checked against all available evidence in each instance.

Examination of these records revealed that overloading, underloading, the vagaries of capacity ratings and the differences in vehicle weight obscured any correlation between costs and rated capacities, and particularly in the tractor-semitrailer field where the rated capacity given was frequently that of the tractor. On the other hand, there appeared to be a clearly defined relation between the average gross weight of the vehicle throughout its annual mileage and its operating performance and costs. In practically every item of expense, the cost per unit of weight was less for the larger gross loads than for the smaller in such a way that the trend of each item could be resolved into a simple logarithmic equation.

Dominant among the causes of cost variation throughout the range of truck operation is this element of gross weight. Vehicle price, actual capacity and annual mileage are related to it. Price and capacity are so related because gross weight represents the quantity of materials and machinery put together in a certain way for a definite load-bearing purpose, plus that load; and annual mileage is related to it because annual mileage determines the spread of the overhead, and the larger the investment the greater will be the pressure toward spreading that overhead or, conversely, if the traffic and mileage requirements are not present the larger investment is less likely to be made. And since all items of cost are in some way related to mileage or to investment, it is only natural that they will also relate to weight.

In a generalized analysis, gross weight affords a substitute for the factors of performance capacity and actual performance, i.e., the sixth source of variety outlined. It is readily computed and its elements are simple. Performance capacity is far more complex and would perhaps be quite difficult to obtain through questionnaire responses. The curves representing the equations obtained for each item and shown in the four cost determination charts herein, may therefore be said to be curves of this sixth variable, with all other variables averaged.

No discussion of truck operating costs can at present be complete without reference to accounting and account classifications. The great body of American truck operators consider the subject as having merely a theoretical importance. They



Determining motor truck operating costs — section four.

can scarcely be blamed. A large number of excellent classification systems have been developed, which differ only in minor respects from each other, but which enjoy a common failing in that their usefulness rarely goes beyond the requirements of the auditor and the finance company. The reason is that very little, if any, stress is placed on the maintenance of the necessary statistics by which they may be put to practical service in the day-to-day conduct of the operation.

The accounts of each vehicle should be kept separately. And jointly with those accounts should be kept a detailed physical description as to performance capacity and changes in performance capacity due to tire size changes, gear ratio changes and to changes in the unladen weight. Mileage, load, speed, grade and road surface records are also essential; while tire pressure, atmospheric temperature and traffic or delivery stop records are desirable.

With the aid of such statistics the cost record can throw valuable light on the relative efficiency of different vehicles and the profit or loss involved in each phase of the operation, and may ultimately lead to a more general understanding of the complex problem of operating costs.

Foreign Oil Legion

Three well known oil men in London caught in an informal pose by the editor of World Petroleum: Left to right; A Von Hartz, director, Agwi Petroleum Corporation, London, Adrian Corbett, public relations official in London for the Royal Dutch Shell Group, and Bruce Aldrich, in charge of asphalt marketing operation in Europe for Jersey Standard interests.

M. BARINOV, head of Glavneft, and one of the most important men in the Soviet oil industry, arrived in the United States on March 17 accompanied by a commission of experts consisting of L. Nersessov, and Engineers Gurevitch, Ginsberg and others. Mr. Barinov expects to remain in New York City for a brief visit and then return direct to Moscow.

G. S. WALDEN, chairman of the board, Standard Vacuum Oil Company, accompanied by Mrs. Walden arrived in London and have been staying at the Savoy.

Dr. JOHN H. MAXSON, geology instructor at the California Institute of Technology, recently left Pasadena en route for the Near East to assist the Turkish Government in carrying on oil exploration activities. Leave was requested from the Institute for Dr. Maxson by the Turkish government's petroleum department. Dr. Maxson's work will come under the Maden Tetkik ve Arama Enstitutusu (Turkish Bureau of Mines and Geological Survey) which is headed by an American, Mr. H. M. Kirk who recently visited the United States. Dr. Maxson, whose headquarters will be at Ankara, reached Turkey during the latter part of March. His duties will consist of organizing and directing the work of several exploratory parties which will carry on a search for petroleum coal, and metal ore deposits. Exploratory work that has already been done under the energetic leadership of Mustapha Kemal Ataturk Ghazi has disclosed promising areas for the discovery of oil.

AMOS K. GORDON of Baton Rouge, Louisiana, vice president and treasurer of Standard Oil Company of Louisiana, retired April 1, ending 44 years continuous service with Standard Oil Company of New Jersey interests.

P. E. LAKIN'S appointment as vice president in charge of marketing, has just been announced by Alexander Fraser, President of the Shell Petroleum Corporation, St. Louis. Mr. Lakin, who succeeds Mr. L. van Eeghen, resigned, was formerly general sales manager and concurrent with his becoming an officer of the Corporation has taken over the combined duties of vice president and general sales manager. He was born in Tacoma, Washington, and received his early education in that city, later attending the University of California, and becoming associated with the Shell organization in 1915. He has been with Shell continuously since then, with the exception of the World War period, when he served overseas as a First Lieutenant in the 96th Aero Squadron.

P. E. Lakin

World Oil Production—Official Figures for 1935 and 1936 Revised

All figures furnished direct to WORLD PETROLEUM by Governments, except where otherwise specified

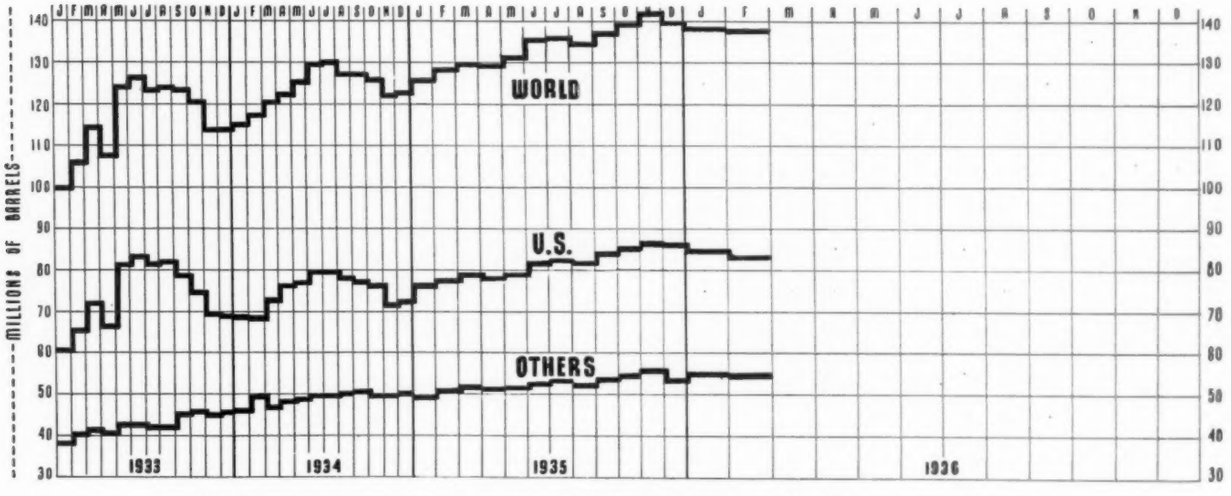
(Figures in U. S. Barrels—Conversion ratio 7 bbl. = 1 ton)

Country	March 1935	April 1935	May 1935	June 1935	July 1935	August 1935	September 1935	October 1935	November 1935	December 1935	January 1936	Provisional Figures February 1936
United States	81,488,000	78,427,000	82,454,000	82,338,000	85,485,000	84,816,000	84,109,000	88,160,000	86,475,000	88,711,000	88,820,000	80,458,850
Russia	14,140,700	14,092,400	15,248,800	14,232,400	14,777,000	15,091,300	14,849,100	16,040,500	16,050,000[1]	16,100,000[1]	16,500,000[1]	15,400,000
Venezuela	11,703,825	11,869,900	12,175,022	13,075,118	13,429,885	12,628,067	13,151,362	13,681,619	13,152,776	13,303,511[1]	13,487,089	12,849,480
Roumania	5,256,000	5,008,000	5,035,000	4,842,000	5,075,000	5,030,000	4,932,000	5,181,000	5,215,000	5,361,000	5,242,000	4,809,000
Iran[2]	4,879,000	4,088,000	3,927,000	4,200,000	4,249,000	4,634,000	4,270,000	4,109,000	4,522,000	4,816,000	4,627,000	4,480,000
Netherland India	3,539,564	3,438,848	3,517,360	3,463,061	3,531,857	3,699,430	3,661,259	3,767,596	3,528,889	3,612,056	3,614,436	3,382,241
Mexico	3,519,148	3,120,035	3,529,659	3,453,871	3,573,632	3,570,908	3,442,259	3,461,457	3,340,713	3,666,265	3,377,302	3,285,777
Iraq	2,238,838	1,980,174	2,034,753	1,993,586	2,445,625	2,166,794	1,962,541	2,374,393	2,309,867	2,240,819	2,327,332	2,204,629
Colombia[4]	1,466,821	1,377,299	1,486,896	1,518,460	1,639,054	1,567,307	1,555,676	1,623,372	1,582,952	1,004,474	1,611,618	1,475,403
Peru[5]	1,395,532	1,329,215	1,451,436	1,414,588	1,448,225	1,442,565	1,448,133	1,493,236	1,343,848	1,381,031	1,377,006	1,293,627
Argentina	1,260,468	1,514,968	1,203,017	1,161,638	1,198,550	1,198,537	1,152,919	1,200,698	1,193,434	1,304,554	1,195,000[1]	1,117,892
Trinidad	919,848	899,946	953,108	972,904	988,341	1,003,382	992,445	1,015,492	1,078,957	1,086,530	1,079,082	983,424
British India	773,572	756,461	794,968	768,692	791,774	796,150	775,133	760,182[1]	735,660[1]	770,182[1]	760,182[1]	711,138
Poland[1]	309,000	330,000	340,000	314,490	324,973	274,040	308,220	318,494	308,220	318,494	318,494	297,946
Brunei	264,390	267,603	277,550	269,290	283,430	281,400	256,480	233,310	242,900	274,540	253,400	237,930
Germany	277,942[3]	240,464[3]	285,747[3]	257,369[3]	276,990[3]	241,801[3]	229,712[3]	232,659	236,789	263,879	254,492	227,444
Japan	164,174	167,728	154,150	144,160	146,863	152,290	144,312	158,165	145,749	147,827	183,651	154,583
Sarawak	152,250	151,067	155,400	150,850	151,830	154,000	145,600	148,400	141,400	140,700	139,300	127,050
Ecuador	151,366	145,212	147,245	137,806	144,812	135,549	138,986	147,449	143,518	146,541	148,980	139,374
Canada	120,537	108,506	122,636[1]	120,102	118,812	117,652	123,919	122,525	116,756	125,658	121,231	113,883
Egypt	104,419	94,955	100,555	99,260	103,488	104,937	100,954	103,341	96,495	94,969	91,497	97,573
France	44,191	46,284	46,991	46,000	45,276	46,312	43,530[1]	44,981[1]	43,530[1]	44,981[1]	44,981[1]	42,079
Others[1]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total	134,244,585	129,529,065	135,516,293	135,048,645	140,304,417	139,227,421	137,868,540	144,452,869	142,080,453	144,990,011	145,649,073	133,964,323

[1] Estimate. [2] Anglo-Iranian Oil Co. figures revised; fuel oil returned to the ground has been deducted. [3] Thuringia estimated 7,000 bbl.; official figure for Prussia. [4] International Petroleum Company's figures. [5] International Petroleum Company and Lobitos Oilfields Ltd. figures.
Russian Sakhalin included with Russia. Japanese Sakhalin included with Japan.

Official Crude Oil Production Figures for 1932 to 1936

Country	Total 1936	Daily Average 1936	Total 1935	Daily Average 1935	Total 1934	Daily Average 1934	Total 1933	Daily Average 1933	Total 1932	Daily Average 1932
United States	169,278,850	2,821,314	993,942,000	2,723,129	909,107,000	2,490,704	898,874,000	2,462,670	785,159,000	2,145,243
Russia	31,900,000	531,667	176,688,100	469,608	168,648,700	462,051	149,901,900	407,950	149,719,000	409,070
Venezuela	26,336,569	438,943	152,277,104	417,198	142,072,329	389,239	120,882,802	331,186	119,596,512	326,766
Roumania	10,051,000	167,517	61,150,000	167,534	62,006,000	169,879	50,971,200	139,647	50,491,205	137,954
Iran	9,107,000	151,783	52,413,879	143,600	52,663,782	144,284	49,581,280	135,840	45,122,455	123,285
Netherland India	6,996,677	116,611	42,569,625	116,629	42,289,408	115,861	38,512,663	105,516	39,584,027	108,153
Mexico	6,663,079	111,051	40,234,902	110,233	38,167,022	104,567	33,904,882	92,890	32,802,285	89,624
Iraq	4,531,961	75,533	24,850,924	68,085	7,935,657	21,742	1,200,000	3,288	1,200,000	3,300
Colombia	3,087,021	51,450	17,617,654	49,740	17,340,724	47,509	13,157,127	36,047	16,384,956	44,768
Peru	2,670,633	44,511	16,835,206	46,270	15,936,937	43,663	13,923,281	38,146	9,899,266	26,026
Argentina	2,312,892	38,548	14,317,500	39,226	14,045,652	39,015	13,759,565	38,232	13,166,900	35,975
Trinidad	2,062,506	34,375	11,669,792	31,686	10,894,363	29,847	9,560,039	26,192	10,023,780	27,387
British India	1,471,320	24,522	9,212,103	24,522	8,997,399	24,650	8,721,655	23,893	8,600,312	23,500
Poland	616,440	10,274	3,749,931	10,274	3,697,617	10,130	3,858,085	10,570	3,905,230	10,670
Brunei	491,330	8,189	3,162,614	8,647	2,673,041	7,323				
Germany	481,936	8,032	3,054,023	8,409	2,266,964	6,211	1,712,823	4,692	1,824,019	4,983
Japan	338,234	5,637	1,848,656	5,065	1,484,962	4,068	1,377,761	3,827	1,575,333	4,375
Sarawak	266,350	4,439	1,811,297	5,002	1,948,044	5,337	2,289,472	6,273	2,274,043	6,213
Ecuador	288,354	4,806	1,725,354	4,727	1,655,062	4,534	1,622,624	4,446	1,573,857	4,300
Canada	235,114	3,919	1,433,302	3,927	1,418,810	3,887	1,147,825	3,144	1,054,373	2,880
Egypt	189,070	3,151	1,215,606	3,356	1,479,037	4,052	1,591,495	4,360	1,742,370	4,760
France	87,060	1,451	529,664	1,451	552,000	1,512	552,000	1,515	552,000	1,508
Bahrein			1,264,809	3,465	285,071	781				
Others	150,000	2,500	900,000	2,470	861,000	2,359	432,000	1,184	432,000	1,180
	279,613,396	4,660,223	1,634,474,045	4,464,253	1,508,426,581	4,133,205	1,417,534,479	3,884,022	1,296,682,923	3,544,940



World crude oil production by months, 1933–1936. Chart is weighted to compensate for variation in number of days per month. Ratio of U. S. crude production to world production.

United States

	Daily Crude Oil Production bbl.	Daily Runs to Stills bbl.	Total Motor Fuel Stocks bbl.	Imports for week bbl.	California Shipments East for Week bbl.
Week ending Feb. 22	2,782,000 435,500[1]	2,850,000	69,353,000	1,039,000[2]	152,000
Week ending Feb. 29	2,773,000 436,500[1]	2,875,000	70,837,000	596,000[2]	70,000
Week ending Mar. 7	2,773,000 447,500[1]	2,725,000	72,281,000	1,298,000[2]	80,000
Week ending Mar. 14	2,817,000 450,000[1]	2,815,000	72,722,000	987,000[2]	195,000
Week ending Mar. 21	2,859,500 456,000[1]	2,815,000	73,157,000		

Underlined figures indicate improvement in statistical position—decrease in production, runs to stills, gasoline stock and imports.

[1] Estimated total production of the East Texas field, official and unreported.

[2] Import figures include all oil imported, for domestic use and in bond for re-export, it being impossible to make the separation in weekly statistics.

Federal Developments

THE invalidation of the processing taxes levied under the A.A.A. left the United States Treasury without a vast income which was counted upon. Accordingly, early in March President Roosevelt announced a new tax program directed principally at taxing the undivided corporation profits, the tax on which, as originally proposed by the President, was to be 33⅓ percent and which, it was estimated, would increase the corporation taxes from $980,000,000 currently paid per year to about $1,600,000,000. While revenue was the first and immediate objective of this tax plan, the equality of the taxation and the fact that money could be raised without delay were influencing factors. Many points were immediately raised against the new taxation plan which, while admittedly desirable in the case of corporations controlled by a few large taxpayers which accumulate surpluses so that taxes of such individuals may be reduced, were undoubtedly harmful in the case of a large proportion of corporations which accumulate large surpluses with the necessary objective of carrying such corporations through depression times. The House Ways and Means Subcommittee on Taxation on March 25 approved its report to the full Committee, which was considerably different from the original plan of the Administration and which, in effect, permits corporations to accumulate legitimate surpluses. The approved plan in the case of corporations whose earnings are above $10,000 per year provides for a graduating tax rate on total earnings in relationship to the percentage of earnings withheld from dividends:

Earnings Withheld %	Tax Rate on Total Earnings %
Up to 10	4
10 to 20	9
20 to 30	15
30 to 40	25
40 to 50	35
50 to 57½	42½

These developments are naturally of major importance to the oil industry and to stockholders of the large oil corporations, since the new taxation, when effected, will dictate dividend policies and probably operating policies of a number of the largest corporations.

The Guffey Coal Conservation Act, "little N.R.A.," which has considerable bearing on the oil industry, was attacked in the United States Supreme Court early in March and a decision in the case is anticipated in April.

Effective April 1, Petroleum Conservation Division of the Department of the Interior will replace the Petroleum Administrative Board. The new agency will assist in the administration of the Connally hot oil law and will be a liaison agency between the Federal Government and the Interstate Oil Compact Commission.

Spring Demand Strengthens Refinery and Retail Prices

DURING the past month prices for petroleum and its products have made substantial advances from the low quotations of the winter, and further strengthening was apparent at the end of March. Motor fuel prices were influenced by a continued high rate of consumption, above the comparable months of 1935, while natural gasoline prices continued seasonably weak. Kerosene quotations further advanced in Group 3, Oklahoma market, in anticipation of the spring farm demand and because of the heavy drain on stocks during the past winter. The price of crude oil was sustained throughout the United States and an advance of 10 to 15 cents per barrel is now anticipated for May or June. However, the oil companies hesitate to initiate such an advance either at this time or later, because even the current prices have resulted in increased production of hot oil. The new Rodessa field in Louisiana is probably contributing the largest proportion of illegal production, though some increase has been noted in the East Texas field, which is currently responsible for about 13,000 to 15,000 bbl. per day of hot oil. Some scattered fields along the Texas Gulf Coast are also contributing a sizeable amount to production in excess of allowables, the estimates ranging from 10,000 bbl. to as high as 20,000 bbl. per day. The Texas Railroad Commission is attempting to check this overproduction in the Gulf Coastal area, but so far is not meeting with much success, while in Louisiana more stringent proration laws are being drawn at this time, which will probably result in stabilized conditions within the next few months.

Retail prices throughout the United States improved appreciably in March. Tank wagon /service station motor fuel prices per gallon, regular grade, including all taxes, in representative districts at the end of March were: 14.2/19.2 cents in metropolitan New York; 14.3/17.8 cents in Newark, N. J. (up 0.5/1.0 cents per gallon); 13.0/16.5 cents in Boston, Mass. (up 0.5/0.5 cents per gallon); 12.0/15.5 cents in Providence, R. I. (up 0.5/0.5 cents per gallon); 14.5/16.5 cents in Chicago; 17.5/19.5 cents in Ohio; 12.5/13.5 cents in San Francisco (off 1.5/1.5 cents per gallon), 12.5/13.5 cents in Los Angeles; 15.0/19.0 cents in Oklahoma; 13.0/17.0 cents in Dallas and Fort Worth; 14.0/18.0 cents in Houston (off 1.0/1.0 per gallon), with third grade gasoline in East Texas area selling at 12 to 13 cents per gallon at independent service stations; 15.7/17.7 cents in St. Louis; and 19.5/22.0 in Montreal, Canada; all with a 2-cent differential for the premium grade. The weakness of retail prices in Texas was definitely influenced by the availability of gasoline without federal tenders, not only in the East Texas field, but apparently also along the Gulf Coastal area, this gasoline moving in intrastate commerce by trucks.

Refinery gasoline quotations in the Mid-Continent area remained unchanged with much firmer undertone at the end of the month. Refinery gasoline was quoted on March 25 at 5–5⅛ cents per gallon for 58–60 U.S.M. grade, 62.9 and below octane rating in Group 3, Oklahoma market; while 63.0–70.9 octane rating, U.S.M., regular grade was quoted at 6–6⅛ cents per gallon. East Texas refinery markets improved during the past month, the third grade refinery gasoline eligible for interstate tenders being quoted on March 25 at 4⅞–5 cents per gallon, while the gasoline restricted to intrastate commerce could be bought for 3¾–4¼ cents per gallon. On the East Coast at Bayonne, U.S.M. grade, 60.0–64.9 octane rating gasoline remained unchanged at 6¾ cents per gallon (3.99 cents gold*). Gulf Coast quotations for export continued unchanged during the past month at 5½ cents (3.25 cents gold*) for grade 58–60 U.S.M.

Natural gasolines continued seasonably low and on March 25 grade 26–70 was quoted at 3–3⅛ cents per gallon (1.80 cents gold*) in Oklahoma; at 3 cents per gallon (1.77 cents gold*) in North Texas; and at 3⅜ cents per gallon (1.98 cents gold*) in North Louisiana.

Kerosene quotations were influenced by the accumulations by the jobbers for the spring

*U. S. dollar at 41 percent discount.

farm demand in the Group 3, Oklahoma market, while elsewhere kerosene prices remained firm and unchanged. On March 25 grade 41–43 w.w. was quoted at 4⅛–4⅜ cents per gallon in Group 3, Oklahoma market; and at 5¼ cents per gallon (3.10 cents gold*) on the East Coast at Bayonne. Gulf Coast prices for export remained firm and on March 25 kerosene was quoted at 3⅞ cents per gallon (2.92 cents gold*) for 41–43 p.w. grade and at 4 cents per gallon (2.36 cents gold*) for 41–43 w.w.

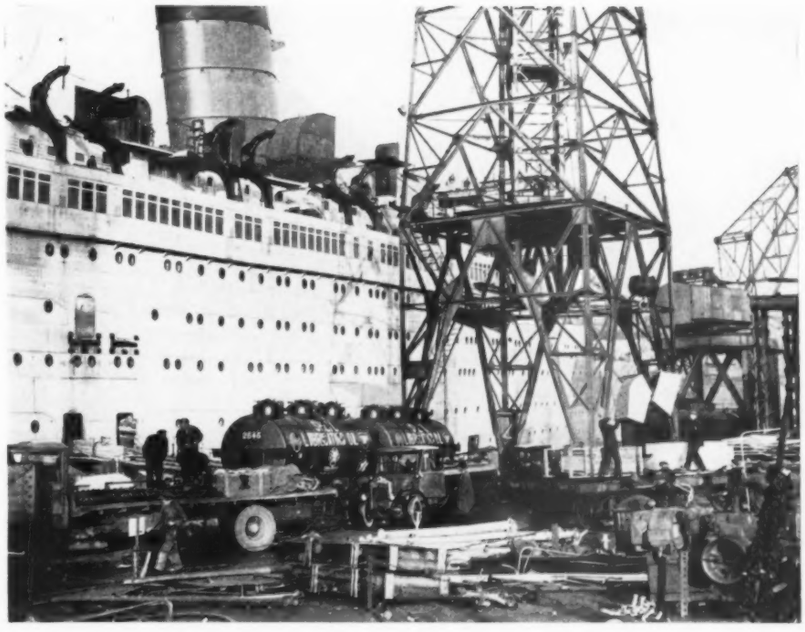
Fuel oil and furnace oil demand became seasonably slower in March and prices weakened about ⅛ to ¼ of a cent per gallon. On March 25 No.1 p.w. furnace oil was quoted at 3⅝ to 3¾ cents per gallon and U.G.I. gas oil was quoted at 2½ to 2⅝ cents per gallon, all in Group 3, Oklahoma market.

Imports and Exports

DURING January of 1936 total gross imports of crude petroleum and all its products into the United States amounted to 3,563,000 bbl. (116,000 bbl. per day) as compared with 5,054,000 bbl. (163,200 bbl. per day) imported during the preceding month; out of this total during January, 1936, 2,421,000 bbl. (78,000 bbl. per day) were imported for domestic use and 1,142,000 bbl. (37,800 bbl. per day) were imported in transit either for refining and re-export or for use in vessels in foreign trade. During the preceding month, December of 1935, 3,788,000 bbl. (122,000 bbl. per day) were imported for domestic use and 1,266,000 bbl. (40,800 bbl. per day) were imported in bond as indicated above. There was a drastic drop in the imports of crude oil for refining and re-export, such imports during January, 1936, amounted to but 27,000 bbl. as compared with 211,000 bbl. imported during December of 1935. During January, 1936, the net imports for domestic use of 78,000 bbl. per day were accordingly 28 percent under the former federal recommendation of 108,400 per day, which was effective under N.R.A.

Exports of crude petroleum and all its products during January, 1936, decreased appreciably for the second consecutive month (dropping 12.46 percent below the daily rate of the preceding month), amounting to 10,162,000 bbl. (327,000 bbl. per day) as compared with 11,610,000 bbl. (374,500 bbl. per day) which were exported during December of 1935, thus declining to the average level of 1934, which was some 100,000 bbl. per day below the exports during the second half of 1935. However, the exports of petroleum products from the United States are usually small during the first two months of the year, and April or May exports will be more indicative of the rate which can be anticipated during the balance of 1936. The January, 1936, total exports were 15.75 percent above the shipments in January of 1935 when 8,780,000 bbl. (283,000 bbl. per day) were exported. Exports of crude oil from the United States during January of 1936 declined sharply to 3,067,000 bbl. (98,000 bbl. per day) as compared with 4,098,000 bbl. (132,000 bbl. per day) shipped in December of 1935, a drop of 25.2 percent; in January of 1935, 2,369,000 bbl. (76,300 bbl. per day) of crude oil were exported. Therefore, in January of 1936 crude oil exports constituted 30.2 percent of the total exports of all petroleum products.

*U. S. dollar at 41 percent discount.



The pride of an entire nation in the great new super liner **QUEEN MARY** *is reflected in the eagerness of British companies to identify themselves with some phase of her equipment or operation. The accompanying illustration, supplied by Shell, shows two of the company's tank cars delivering lubricating oil for the ship's turbo generators which are of sufficient power to provide all the electricity needed for a city of 150,000 inhabitants.*

For the whole year of 1935 the gross value of exports of crude petroleum and of all its products amounted to $249,103,626, as compared with the gross value of all petroleum imports of $37,345,839, leaving, therefore, a large favorable balance of $211,757,787. Gasoline and natural gasoline led in the value of exports in 1935, its exports being valued in that year at $67,051,318; followed by lubricating oil and greases valued at $66,380,260; followed by crude oil valued at $61,176,235; by fuel or bunker oil for vessels in foreign trade (not included in the domestic exports) valued at $29,924,908; by gas and fuel oil valued at $17,483,804; by kerosene valued at $15,148,753; and by residual fuel oil valued at $9,532,695. Of the fuel or bunker oil used in vessels in foreign trade, American vessels used 17,106,206 bbl. valued at $16,325,317, while vessels of other countries used 13,197,525 bbl. valued at $13,599,591. The above import figures include imports in bonds, and after such imports, valued at $12,497,672, are excluded, the net favorable balance for the United States is $224,255,459.

Crude Production

CRUDE oil and natural gasoline production during February of 1936 continued at the high rate of about 2,940,000 bbl. per day, this figure including between 20,000 and 30,000 bbl. of hot oil production in Texas and Louisiana oil fields. The February, 1936, crude oil and natural gasoline production was 231,000 bbl. per day above the production in February of 1935, an increase of 8.52 percent. The largest proportion of the overproduction was derived from California, which exceeded its quota by 1,775,000 bbl. or by 11.53 percent, this being a vast improvement as compared with the figures of the preceding month when the quota in California was exceeded by 5,020,000 bbl. or 31.38 percent. In February, Louisiana oil fields overproduced 1,578,000 bbl. or 37.1 percent, this overproduction being above the quota set by the Bureau of Mines, though it was reasonably well within the state allowable and, therefore, not subject to the operation of the Connally hot oil law. The state of Texas made a remarkable record during February, overproducing but 106.000 bbl. or 0.34 percent. Likewise, small overproduction was recorded in Oklahoma and Kansas, which exceeded their respective quotas by only 717,000 bbl. and 57,000 bbl.

Crude oil runs to stills during February, 1936, averaged about 2,820,000 bbl. per day, or 53,000 bbl., above the runs to stills during the preceding month when 2,767,000 bbl. were processed per day. Total stocks of petroleum products declined 365,000 bbl. during January, 1936, to a total of 541,335,000 bbl. indicating minimal daily gross withdrawals of 11,800 bbl.

Motor Fuel Demand

INDICATED domestic demand for motor fuel during January, 1936, averaged 1,050,000 bbl. per day, 3.49 percent below the average during the preceding month, when 1,088,000 bbl. were consumed per day; the domestic demand during January, 1936, was 145,000 bbl. above the domestic motor fuel consumption in January, 1935, an increase of 16.0 percent; and 89,000 bbl. per day above the domestic motor fuel consumption in January of 1934, an increase of 9.25 percent.

During January, 1936, 83,000 bbl. of motor fuel per day were exported from the United States, 20.93 percent below the motor fuel shipments of the preceding month; 20.30 percent above motor fuel exports in January of 1935, and 32.55 percent above motor fuel exports in January of 1934.

On February 1, 1936, motor fuel stocks at the refineries, plants, terminals and in transit, inclusive of natural gasoline, amounted to 62,613,000 bbl., an addition to storage of 8,268,000 bbl. as compared with stocks on hand January 1, 1936, indicating that during January motor fuel supply exceeded demand by 266,800,000 bbl. per day.

Business Steady

THE New York Times weekly business index reached a high point of 96.7 at the close of December and during the first half of January, but dropped to around 95 during the second half of January, continuing at that level throughout February and the first half of March, the decline being in part influenced by severe weather conditions and floods in the United States. The New York Times index stood at 95.4 for the week ending March 14, 1936; at 86.5 on March 1, 1935; at 84 on March 1, 1934; at 62½ on March 1, 1933; at 72 on March 1, 1932; and at 88 on March 1, 1931, thus indicating that the present improvement in general business conditions suggests definitely the passing of the worst phase of the depression, and also suggests continuation of the present firm trend without much variation during the next few months.

Oil Field Developments

Texas

IN Titus County of northeast Texas, about 50 miles due north from the north end of the East Texas field, Peveto, Housh and Thompson No. 1 Carr in the M. V. Delgado survey, 1½ miles east from Talco, tested up to 600 bbl. of 27 gravity crude oil initially per day on pump from the Paluxy sand of Upper Trinity, Lower Cretaceous, at a depth from 4,200 to 4,208 ft. The bringing in of this important wildcat precipitated an extremely active and promising leasing campaign that extended for a distance of some 200 miles from Mexia-Powell district to the Arkansas state line, through Kaufman, Hunt, Hopkins, Franklin, Titus, Morris, Bowie and Cass Counties. This territory has been tested in the past by several hundred wells drilled to the Woodbine sand along the faults of the major Balcones Fault Zone, and hence both the surface and subsurface structure of the area has been generally known. Of all the Woodbine sand wells drilled in northeast Texas, but six penetrated either the Paluxy sand or the underlying Glenrose oölitic limestone section. The discovery of large flowing production in the Glenrose in Rodessa field attracted new attention to northeast Texas, but it was not until the Peveto et al No. 1 Carr actually showed commercial production that the whole country became immediately active and swamped with geologists, geophysical crews, lease brokers, scouts, etc. It is indeed doubtful if within the next few months any acreage within miles of the Fault Zone will remain unleased. Humble Oil and Refining Company has done most of the exploration work in the area for several years past and is the largest lease holder along this section of the Fault Zone. The principal interest in the area remains in the probable Glenrose flush production, similar to Rodessa, though the present Paluxy production apparently represents a new oil reserve of some magnitude.

Humble Oil and Refining Company started three wells near the Talco discovery and its No. 1 King and Hughes extended the Paluxy sand production 2½ miles due southwest from the discovery by flowing naturally at the rate of about 500 bbl. per day from 4,191 ft. Same Company's No. 1 Groves, located 1½ miles due east from the discovery test, missed the oil zone in the Paluxy sand altogether, however, and at this writing is being carried to the Glenrose, drilling at 4,350 ft.

Louisiana

THE Rodessa field, in northwest Louisiana and northeast Texas, was defined on its northeast side by the Lion Oil Refining Company's No. 1 Wynn in section 9, T. 23 N., R. 15 W., which tested salt water at a total depth of 6,157 ft. in the Oölitic limestone (Young zone). Total number of producing wells in the Rodessa field reached 120 at the end of March, of which four were in Cass County, Texas, while some 40 operations are currently active in the field. With current allowable of 400 bbl. per well per day the total production from the field is approaching 50,000 bbl. per day. The present area proven for production is about 5,000 acres, and calculating on the basis of an average recovery per acre of 20,000 bbl., the indicated reserve is some 100,000,000 bbl. Some overproduction was reported in the Rodessa field above the state allowable, but the poor quality of the straight-run gasoline from the Rodessa crude oil, which tests but 40 octane, makes it very difficult for the operators to dispose of such excess production since only refineries with most modern cracking equipment can use this crude oil. By comparison, the straight-run gasoline from the East Texas field tests 57 octane, thus making it apparent that there is no danger of small bootleg plants refining Rodessa crude oil, since such straight-run gasoline would not be at all adaptable, regardless of price discounts, to the modern high compression automobile motors.

Independent Exploration Company scored another reflection seismograph discovery when Superior Oil Company and Woodley Oil Company No. 1 Bradley in section 51, T. 7 S., R. 1 E. on the Bayou Mallet prospect of Acadia Parish was brought in for 1,200 bbl. initially per day through ¼-inch choke from 6,385 to 6,389 ft., with a total depth of 7,900 ft. Schlumberger surveys were made in the well prior to the completion. Additional development will be necessary in Bayou Mallet before its economic importance is fully determined, because in this section of Louisiana producing sand thicknesses are usually very thin and conducive to large recoveries per acre, though large areal extent may compensate for thin sand body.

Oklahoma

THE comeback of the Oklahoma City field continued during February and March with several additional large completions on the north end of the field. At this time there are 13 producing wells in this extension, which currently produce about 25 percent of the Oklahoma City's total production, and some 50 locations are active. At the close of March Oklahoma City voted to add about 800 acres to the drilling zone of the field, and this extension presages further extension of some 600 acres on lands owned by the state and also on other tracts within the city. These total extensions probably will result eventually in the drilling of some 250 to 300 wells, doubling the present Wilcox sand productive area of the field and greatly increasing its cumulative recovery. British-American Oil Producing Company and the Phillips Petroleum Company will benefit most from the Oklahoma City north extension, as they hold the best looking acreage in that area.

The Billings field, in Noble County, witnessed in February an important discovery of deeper production when Phillips Petroleum Company and Shell Petroleum Corporation's No. 1 McCaughtry in section 21, T. 23 N., R. 2 W., on the southwest edge of the field, was completed for 17,500 bbl. initially of 42 gravity crude oil from a total depth of 4,258 ft. in the

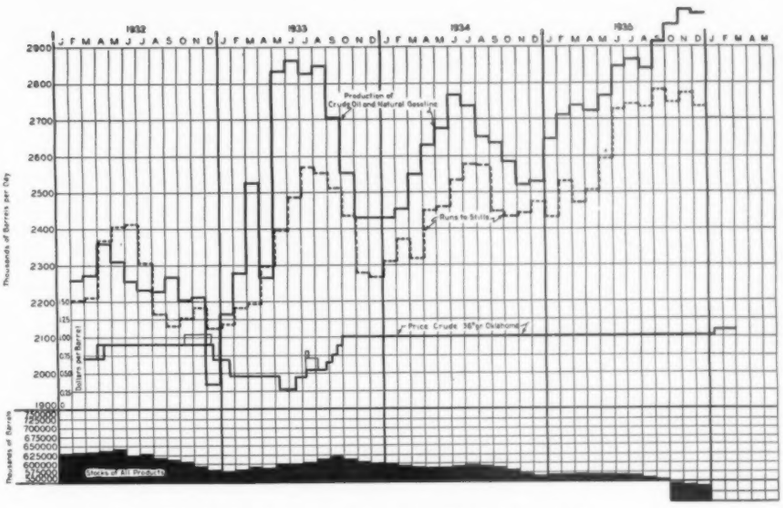
Effect of Bureau of Mines Recommendations in Principal Oil Producing States

	February, 1936				March 1936		
	Total Production bbl.	Percent of Total U. S. Production	Bureau of Mines Quota bbl.	Over-production bbl.	Bureau of Mines Daily Quota bbl.	Daily Average Production Week Ending March 7 bbl.	Daily Average Production Week Ending March 14 bbl.
Texas	31,056,000	38.6	30,950,000	106,500	1,104,000	1,116,500	1,116,000
California	17,155,000	21.3	15,380,000	1,775,000	538,800	569,000	566,000
Oklahoma	14,757,000	18.3	14,040,000	717,000	506,300	473,000	515,000
Louisiana	5,608,000	7.0	4,090,000	1,518,000	151,400	191,000	193,000
Kansas	4,047,000	5.0	3,990,000	57,000	142,000	141,000	141,000
Total United States	80,458,000	100.0	76,800,000	3,658,000	2,738,900	2,773,000	2,817,000

Wilcox sand of Simpson series. The Billings field is located on a truncated pre-Pennsylvanian anticline with the Arbuckle limestone directly underlying the Pennsylvanian formations, and the earlier deep wells tested semi-successfully the best part of the structure without finding large production and usually encountering salt water together with the oil. The new deep discovery is the result of the exploration of the flanks of the Billings structure, which was conducted in the hope, now justified, of finding the truncated Simpson series above the water level in its sands. It is not anticipated that the new discovery will cover a large area, the producing section of the Wilcox sand probably being very narrow and irregular in its extent, and therefore the Billings field will continue to be of but local interest and value. Of greater importance is the attention called by the new discovery to the old Garber pool, a much larger structural feature, where similar truncation of Ordovician sediments has been known for years and where new exploration of the flanks of the field will be undoubtedly actively undertaken with an excellent chance of discovery, though the search may be long and expensive.

In the Lovell field in Logan County, the Stanolind Oil and Eason Oil Companies' No. 1 Gragg-Bird in section 20, T. 18 N., R. 4 W. opened an important west extension in the deeper Simpson series, with the well producing 1,500 bbl. per day of 60 gravity crude oil from a total depth of 6,145 ft. The discovery is credited to the detailed seismograph work by the Geophysical Research Corporation (Amerada).

BASIL B. ZAVOICO



U. S. production, runs to stills and price of crude oil in relation to stocks of all petroleum products.

▼

Gulf Export Prices for Major Oil Products

	Products	Cents per Gallon			
		Feb. 26	Mar. 4	Mar. 11	Mar. 18
Gasoline:	U. S. Motor	5½	5½	5½	5½
	64/66–375 E.P.	6	6	6	6
	59 Octane & below	5⅝	5⅝	5⅝	5⅝
	65 Octane & above	6⅛	6⅛	6⅛	6⅛
Aviation Gasoline:	73 Octane & above	9¾	9¾	9¾	9¾
Kerosene:	44 w.w.	4¼	4¼	4¼	4¼
	41–43 w.w.	4	4	4	4
	41–43 p.w.	4	4	4	4
Gasoil:	26–30 translucent	3⅛	3⅛	3⅛	3⅛
	30 plus translucent	4¼	3¼	3¼	3¼
Fuel oil:	Grade C Bunker (per bbl.)	$ .90	$ .90	$ .90	$ .90
	Cargo lots (per bbl.)	$ .79	$ .75	$ .75	$ .78
	Diesel oil (per bbl.)	$1.50	$1.50	$1.50	$1.50
Lubricating Oil:	Bright Stock No. 8	26	26	26	26
(New York Export	Bright Stock No. 6½	25½	25½	25½	25½
Market)	Warren E.	20½	20½	20½	20½
	600 Unfiltered	17	17	17	17
	650 Unfiltered	18½	18½	18½	18½
	600 Flash s.r.	19½	19½	19½	19½
	650 Flash s.r.	24½	24½	24½	24½
	Neutral 200 No. 3	29	28½	28½	28½
	Neutral 150 No. 3½	24½	24	24	24
So. Texas:	Red oil 300 No. 5–6	7¼	7¼	7¼	7¼
	750	9	9	9	9
	1200	9½	9½	9½	9½
	Pale oil 500	7⅞	7⅞	7⅞	7⅞
	750	9	9	9	9
	1200	9½	9½	9½	9½
Crude Oil:	East Texas crude delivered at Gulf port for Export	$1.36	$1.37½	$1.37½	$1.37½
	Venezuela crude	.83	.83	.83	.83
	Trinidad crude	.85	.85	.85	.85
	Panuco crude	.85	.83	.83	.83

British Imports Decline

DURING February British oil imports declined substantially as compared with both the previous month and February, 1935. The large reduction in gasoline was due to smaller receipts from Iran and Dutch West Indies. Lube imports, on the other hand, were exceptionally good owing to increased imports from the United States and Russia.

Total imports for the two months of 1936, however, are only slightly below figures for the corresponding period of last year, having been bolstered by the large January arrivals.

British Oil Imports by Products

(Bbl.)

	February 1936	2 months to Feb. 29, 1936	2 months to Feb. 28, 1935
Kerosene	359,661	996,541	1,114,258
Motor spirit	2,232,653	5,341,796	5,290,282
Lubricating oil	320,028	562,199	368,490
Gas oil	219,172	477,828	758,886
Fuel oil	1,492,769	2,633,179	2,936,228
Other sorts	7,887	39,085	99,656
Total Products	4,632,170	10,050,628	10,567,800
Crude	1,094,658	2,334,172	2,112,543
Total Imports	5,726,828	12,384,800	12,680,343

World Petroleum Abstracts

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Industry. *Edited by Dr. O. W. Willcox*

Petroleum Geology

HOSKINS MOUND SALT DOME, BRAZORIA COUNTY, TEXAS.—Archer H. Marx, in BULL. AM. ASSOC. PETROLEUM GEOLOGISTS, vol. 20 (1936), No. 2, pp. 155–178.

Hoskins Mound is a typical Gulf Coast salt dome situated in southeastern Brazoria County, Texas. It has a low topographic mound, roughly circular in outline and characteristic of the intrusion of a salt plug into the overlying Tertiary and later formations found in this region. The salt is capped by anhydrite and limestone, with commercial deposits of sulphur occurring in the limestone on the flanks of the dome. Drilling has well outlined the cap rock which underlies between 400 and 500 acres of the dome area. The sulphur is secondary and later than the anhydrite and limestone.

Since 1923, sulphur mining has been carried on by the method known as the Frasch process, in which superheated water is pumped into the formations and melts the sulphur. The sulphur collects at the bottom of the well and is brought to the surface by means of an air lift. To date, more than 4,000,000 long tons of sulphur have been produced from Hoskins Mound.

Between 1905 and 1915, approximately 500,000 bbl. of oil were produced from sands and sandstones immediately above the cap. Only a few off-dome tests have been drilled, and consequently very little information is available in regard to the oil possibilities of the lateral beds abutting the dome.

MIOCENE STRATIGRAPHY AND PALEONTOLOGY OF PALOS VERDES HILLS, CALIF.—W. P. Woodring, M. N. Bramlette and R. M. Kleinpell, in BULL. AM. ASSOC. PETROLEUM GEOLOGISTS, vol. 20 (1936), No. 2, pp. 125–149.

The Miocene of the Palos Verdes Hills embrace a thickness of about 2,500 ft. of rocks here designated as Monterey shale, and the base is not exposed in the region where the oldest beds crop out. Five main lithologic units are recognized, consisting, in ascending order, principally of silty shale, porcelaneous and cherty shale, phosphatic shale, diatomite, and radiolarian mudstone. Three local members are named and mapped, the lowest one of which includes three of the main lithologic units and also two named tuff beds. *Foraminifera* are found in all the main units and are assigned to nine faunal zones indicating a time range extending from early Middle Miocene to the top of the Upper Miocene, as these terms are generally used in Coast Range chronology. These beds overlap northward onto a schist basement of Franciscan (?) rocks, and this northward overlap apparently continues to the Torrance and Playa del Rey oil fields in the southern part of the adjoining Los Angeles Basin. Mollusks from detrital rocks at the base of the overlapping beds on the north slope of the hills represent a fauna that in many respects is a new one for the Coast Ranges, as it includes a number of tropical genera not heretofore recorded there.

APPLICATIONS OF AERIAL PHOTOGRAPHY.—Dennis S. Sneiger, in OIL WEEKLY, vol. 80 (1936), No. 8, pp. 19–21.

The oil and gas industries have found aerial photography of great use in solving vital problems. Its principal value lies in the saving of time and expense in obtaining preliminary information for geological and geophysical investigations, and in pipeline surveys. An aerial map is often invaluable to the geologist, as it is likely to be far more accurate than any ordinary topographic map; besides showing topographic details, the aerial photograph discloses outcrops, faults, contact swings, and other indications of geological structure that can be ascertained only by days or months of patient field work. This saving of time is of great monetary importance in opening and leasing a new field. In the matter of leasing the aerial photograph discloses the position of a property with indisputable accuracy, which cannot be said of ordinary county maps in many parts of the country. Another obvious application of aerial photography is in selection of the most practicable routes for pipelines.

CLASSIFYING OIL SAND CORES.—James H. Gardner, in OIL AND GAS JOUR., vol. 34 (1936), No. 38, p. 15.

Attention is called to the existence of two distinct types of saturation in an oil sand. Every sand has a certain amount of pore space in which a certain amount of oil will be held by capillary attraction, or, as the physical chemists say, by adsorption. When the sand contains just enough oil to satisfy the adsorbing or capillary property the core will not drip oil, nor will the well be free flowing. It is only when there is more than enough oil to "wet" the sand grains that a free flow of oil will be obtained; such a sand is said to be "supersaturated." The difference between the "free" and the "adsorbed" oil represents the ordinary recovery of the well. In other words, an oil-saturated core does not make an oil well; it is the supersaturated oil sand that produces oil. It is important for the geologist, the driller and the layman to carry this distinction in mind.

It is also a fact that a sand may be saturated (in the above sense) and the rest of the pore space may be filled (or supersaturated) with gas or salt water. This requires that cores be classified in accordance with some such scheme as the following:

Sand Saturation	Sand Super-saturation	Test Results
Oil	Oil	Oil well
Oil	Oil and gas	Oil and gas well
Oil	Gas	Gas well (with distillate)
Oil	Salt water	Salt water well (show oil)
Oil	Oil and salt water	Oil and salt water well
Gas	Gas	Gas well
Salt water	Gas	Gas well (with salt water)
Water	Water	Water well
Oil	None	Dry; show oil
Gas	None	Dry; show gas
None	None	Dry; thief-sand, if porous

Where salt water is present in a sand it is often very difficult of detection in a core sample. While the core is being cut, the fresh water (with mud) that fills the hole is under hydrostatic pressure greater than the salt-water pressure in the sand; this means a holding back of the salt water and a thorough washing out of the sand core by fresh water. It is thus laundered of its salt-water content just as may be the case of the laundering out of oil supersaturation. So before an actual well test is made it is hard to know what the supersaturation factor really is. The best of experienced heads and the best of laboratory experts are apt to be fooled occasionally on this problem.

Drilling

DUAL POWER ROTARY RIG.—W. C. Lane, in OIL WEEKLY, vol. 80 (1936), No. 10, pp. 26–28.

A drilling company in Kansas is using a light rotary drilling rig which differs from other Diesel driven rigs in that the drawworks is driven by electricity and the slush pumps directly from the engines. Energy for both drives is obtained from a common line shaft coupled to two engines.

The object of using two systems of transmission is to take advantage of the unexcelled flexibility of the speed and torque control inherent in a variable voltage direct-current drive for operating the drawworks and of the high efficiency of the direct-belted drive for operating the pumps. The direct mechanical-drive eliminates the losses in a pump motor, the losses in the generators due to the production of the energy used by such a motor and the losses in the drive incident to transmitting the additional energy. Hoisting work is done with the power of the two engines compounded through the medium of the generator and the drawworks motor.

PROGRESS IN STEAM DRILLING EQUIPMENT.—V. Weaver Smith, in OIL AND GAS JOUR., vol. 34 (1936), No. 39, pp. 29–36.

In the opinion of the author, steam is the ideal power medium for oil well drilling; no other medium provides the same flexibility of operation. But, at the same time, a steam rig may be operating very uneconomically. Within the past few years some oil companies and equipment manufacturers have been

awakening to the advantages of superheated steam, especially with deep well drilling. Lately the A.S M.E. have conducted exhaustive tests on drilling in Oklahoma City and in the Humble field.

The tests in the Humble field are particularly interesting because they show the decided advantage of high degree superheated steam over saturated steam. This test shows a decrease of 11.5 percent in water required and 14.3 percent in fuel required. This does not tell the whole story, however, since no restraint was put on the mud pump or engine and it was found that with the savings of fuel there was also an increase of 16.3 percent more work done resulting in an actual saving of 23.9 percent in water and 26.3 percent in fuel.

A test at Chandler, Okla., shows marked improvement can be obtained when better feed water heaters, engine driven power pumps and improved drilling engines are used in conjunction with a moderate degree of superheat and insulation of boiler and steam lines.

LOST CIRCULATION IN ROTARY HOLES.—W. A. Sawdon, in PETROL. ENG., vol. 7 (1936), No. 5, pp. 27–30.

Although lost circulation in wells may be due to an infinite variety of conditions peculiar to individual formations, the problem has been considerably illuminated by experience in recent years. The method of dealing with thirsty formations may involve a series of treatments. When it is noted that circulation is being lost and the actual subsurface conditions are unknown, the first step is to thicken up the mud to a high colloidal degree. If this does not regain circulation, cottonseed hulls, beet pulp or some similar material that will swell in water may be introduced. When this fails it is considered that the core calls for gelcement. This is a mixture of cement and bentonite. The function of the bentonite, which has no detrimental effect upon the cement when used in proper proportions (4 sacks bentonite to 100 sacks cement), is to make a stiff jelly that will hold the cement until it sets.

Other means of killing off thirsty formations lie in the use of chemicals. For instance, when a solution of sodium silicate is introduced into the well, followed by a solution of aluminum sulphate, the two react to form a stiff colloidal jelly that forms an impervious plaster on porous surfaces. The application of such chemical means should be done under competent supervision.

Oil Well Operation

PROGRESS IN ACID-TREATING WELLS.—J. C. Albright, in PETROL. ENG., vol. 7 (1936), No. 4, pp. 47–51.

This article gives a summary of the great strides that have been made in treating oil wells with acid. First introduced about three years ago, the practice has been extended to nearly all the states and to other countries where oil is found in limestone rock, and most of the treated wells have shown substantial increases in production. There are now in existence numerous companies specializing in the acid treatment of wells, and many of the larger oil companies have organized special staffs of their own for the purpose. The subject is indeed one calling for specialization, because of the variability and complexity of the conditions to be dealt with in individual wells.

Formerly, acid treatment of wells was deferred until production showed signs of falling off. The present tendency is to give the wells a treatment immediately following drilling-in. This is for the purpose of opening up the tighter formations so that the entire formation can be drained uniformly while the formation pressure is still high. Otherwise it may be found that many wells will produce the bulk of their oil from the more open portions of the zone, thus causing the formation pressure to be lowered to a point where the tighter zones can not be produced successfully. In other words, acid treatment in the very early history of the well may lead to a greater ultimate recovery.

In the early days of acidizing oil wells, the acid was permitted to travel largely as it would, which was downward, outward, and always through the path of least resistance. This method did not always produce satisfactory results because the water zone was just as apt to be opened as the oil-producing formation, causing the well to make more water than oil. To overcome this difficulty bottom-hole "blankets" were developed to provide an effective seal to the lower part of the hole, preventing acid from traveling in that direction. Treating wells with blankets is perhaps the forerunner of directional-treating of oil wells. The development of blankets gave the treating companies an opportunity to control the flow of chemicals by preventing it from flowing downward.

The blankets are acid-proof materials, heavier than the treating acid, and do not permit the penetration of acid below the point where they are laid down. Some of the blankets are made of a 40-deg. Baumé solution of calcium chloride, which can be removed from the hole after the treating has been completed. It may, however, be composed of any other chemically inert substance heavy enough to settle to the bottom of the hole and remain in place while the treatment is being carried on.

Further progress is being made in the development of pumping units adapted to the process, in the development of inhibitors to protect the casing, etc., and in the technique of plugging back and perforating the several strings of casing in order to treat upper zones.

WATER FLOODING OF OIL SANDS.—Chas. B. McClintock, in OIL & GAS JOUR., vol. 34 (1936), No. 37, pp. 56–57.

At the present time the largest amount of experience in flooding oil sands has been obtained in the Bradford field of Pennsylvania, where natural conditions are exceptionally favorable for the practice. Formerly, oil sands in this field were flooded simply by allowing the ground water to enter, but inability to control movement of the water by this method has led to the development of various types of "pattern drilling", of which there are six systems, as follows: circular flood, line flood, four spot, five spot, seven spot and nine spot. The systems generally used in the Bradford field are the five spot and the seven spot; the former represents four water-intake wells in the form of a square with a producing well in the center of the square. This type is more readily adaptable to property lines than the seven spot system, in which six intake wells are arranged in the form of a hexagon; however, more water per unit of time can be introduced into the sand by using the seven spot system. In any system the flooding may be "natural", which means flooding by ordinary hydrostatic pressure, or "artificial", if extra pressure is applied at the intake wells by means of a force pump; the artificial method reduces the time required to "water out" a given area, and the general recovery is increased. If sufficient pressure is applied to the intake wells the producing well may be caused to flow. "Delayed drilling" has met with success on certain properties; this method is to drill the intake wells first and saturate these wells with water before drilling the producer.

Any system of flooding must of necessity be based on a thorough knowledge of the underground conditions obtained by careful study of cored sections.

SEALING OFF SALT WATER FROM OIL-BEARING FORMATIONS.—L. G. E. Bignell, in OIL & GAS JOUR., vol. 34 (1936), No. 37, pp. 59–60.

Bottom water has been successfully shut out of a producing well by the use of a patented solution, evidently containing sodium silicate, which forms a precipitate with the calcium and magnesium compounds in the salt water, thus sealing the pores of the sand against the water and obviating "water coning". The method is to place about 100 gal. of the solution in the bottom of the well to about the height of the water cone, and then about 500 gal. of oil, which is used to force the solution out into the sand.

Water may also reach the bottom of the well from overlying horizons, due to imperfect sealing. For such cases, methods have been developed wherein the casing may be perforated and cement injected to shut off the offending horizon.

COMBINATION GAS LIFT AND PUMPING PRACTICE.—J. C. Albright, in OIL WEEKLY, vol. 80 (1935), No. 5, pp. 37–39.

When the fluid level in many wells in the Oklahoma City field had declined to a point such that potentials were much lower under regulation lifting methods, several companies began to look for a method of producing oil from the highly permeable Wilcox sand that would permit obtaining the allowable in a minimum amount of time and which at the same time would establish a high potential flow. It was found that a combination of pumping and gas-lift would give most of the desired factors.

This method consists of using large capacity, bottom-hole, electrically-driven centrifugal pumps equipped with low-horsepower motors for lifting the oil readily to a height of approximately 1,000 ft. and then depending on gas lift for carrying the fluid the remaining approximately 5,000 ft. The hook-up is comprised of a regulation type bottom-hole, submerged, electric pump set in the bottom of a string of two-inch upset tubing that is perforated or slotted at the proper height (usually around 1,000 ft.). The tubing is packed off beneath the perforations.

The pump lifts the oil readily to this height, which varies according to well conditions, then gas lift begins to function and brings the oil to the surface through the casing.

Wells that ordinarily would not produce in

excess of 500 to 750 bbl. per day under ideal conditions, showed potentials running as high as 6,000 bbl. daily under this combination pumping and gas-lift practice. The method not only allows the operator to obtain the well's allocated production in a minimum amount of elapsed time, but when the company is in a position to compress the gas to the required lifting pressure, results in a lifting cost comparable to straight gas-lift practice or to straight bottom-hole electric pumping with centrifugal submerged units.

Natural Gas

Natural Gasoline.—G. R. Hopkins and E. M. Seeley, in MINERALS YEARBOOK, 1935, pp. 21–30.

The salient statistics for natural gasoline in the United States, as gathered by the United States Bureau of Mines for the years 1924 and 1931–34 are condensed in the following table:

Salient Statistics for Natural Gasoline in the U.S., 1924 and 1931–34

	1924	1931	1932	1933	1934
Number of plants operating	1,096	937	830	779	766
Production:					
By States:					
California, millions of gallons	233	680	552	496	506
Texas, do.	187	427	371	367	467
Oklahoma, do.	301	455	379	360	355
West Virginia, do.	62	53	44	40	42
Louisiana, do.	48	58	46	37	41
Other, do.	103	159	132	120	124
	934	1,832	1,524	1,420	1,535
By types of process:					
Compression process, do.	258	212	182	161	148
Absorption and combination processes, do.	672	1,609	1,333	1,251	1,380
Charcoal, do.	4	11	9	8	7
	934	1,832	1,524	1,420	1,535
Stocks at natural-gasoline plants at end of year, do.	(1)	27	19	28 / [2] 42	36
Value:					
Total (at plants), millions of dollars	82	64	49	54	61
Average per gallon (at plant), cents	8.8	3.5	3.2	3.8	3.9
Average spot price, Oklahoma natural gasoline, do.	[3] 8.8	[3] 3.2	[4] 2.3	[4] 2.9	[4] 2.6
Natural gas treated, millions of cubic feet	1,016,276	1,790,119	1,499,756	1,551,464	1,776,172
Average yield per thousand cubic feet, gallons	0.92	1.02	1.02	0.92	0.86

[1] Figures not available.
[2] For comparison with 1934.
[3] Grade A.
[4] Grade 26–70.

These figures bring out the fact that there has been a steady, if small, annual decrease in the number of plants operating in the four depression years. It also appears that in the last three years the compression process has been losing somewhat in favor of the absorption and combination processes, and that the charcoal process does not seem to grow. The volume of gas treated has increased since 1932 but of late the yield per 1,000 cu. ft. has decreased, indicating that leaner gases are being worked.

Stage Separation of Oil-Gas Mixtures.—R. L. Huntington, in REFINER, vol. 15 (1936), No. 2, pp. 65–67.

Stage separation is a process in which mixtures of crude oil and gas, flowing from producing wells, are separated into liquid and vapor phases by two or more equilibrium flashes at consecutively lower pressures.

The development of stage separation has proved to be advantageous to the natural gasoline manufacturer in that (1) the investment in field lines and compressor equipment has been materially reduced as the result of the retention of back pressure on the field separators; (2) the use of gas-lift has resulted in the production of more natural gasoline per barrel of crude oil due to the stripping action of the gas on the crude oil itself; (3) the holding of back pressure on the separators has caused a marked decrease in the entrainment of oil mist into the gas-gathering lines going to the natural gasoline plants.

The disadvantages of stage separation for the natural gasoline manufacturer are as follows: (1) The gasoline plant must install high-pressure and low-pressure gathering systems in order to process the gas production from both the high- and low-pressure separators. Although the gas volumes from the low-pressure separators are usually so small that it is not economical to process them in a low-pressure gas-gathering system, it is well to remember that the gas from these low-pressure separators is much richer than the gas coming from the high-stage separators; (2) Stage separation in itself does tend to decrease the amount of natural gasoline produced per barrel of crude oil, since the approach toward differential liberation of gas tends to hold a higher percentage of the natural gasoline constituents in the crude oil.

The problem calls for more fundamental physical-chemical data from research laboratories, showing the relationships between the crude oil gravity and gasoline content of the gas as a function of such variables as pressure, temperature, gas-oil ratio, and the number of separator stages used.

It is difficult to predict what the future of stage separation will be, but the oil producer and the gasoline manufacturer should be ready to accept the fact that in so far as it is more economical to retain the natural gasoline in the crude oil than it is to manufacture these fractions into natural gasoline, stage separation will be adopted.

Pipelines

Machine for Coating Pipe With Concrete.—Sterling C. Lines, in PIPE LINE NEWS, vol. 8 (1936), No. 3, pp. 5–6.

A machine has been invented by which pipe from 4 to 14 inches in diameter has been coated with cement in layers from ⅝ to 1½ inches thick at a cost of about five cents per lineal foot. This may be of some importance because records of the A.P.I. and A.G.A. studies to date indicate clearly that concrete is a worthy material for pipe protection.

Oxygen Requirement Determines Choice of Fuel in Steel Cutting.—Geo. V. Slottman, in OIL & GAS JOUR., vol. 34 (1936), No. 37, pp. 52–54.

During the past year there has been a tendency to cast doubt on the value of acetylene as a heating gas for steel cutting. Claims have been made that by using fuel gases (such as city gas or oil field gas), considerable savings (as much as 20 percent) can be made in oxygen consumption, and that increased cutting speeds are realizable with city gas over corresponding acetylene practice. To test this allegation a series of investigations has been made, the outcome of which is that, per unit of heat developed, oxy-acetylene flames preheat steel faster than any commercially available fuel gas, and that per unit of heat developed, acetylene requires the least amount of oxygen.

Note:—The same conclusion has been reached in other recent thermochemical research. However, this need not deter oil field men, having plenty of compressed natural gas at their disposal, from doing light jobs without acetylene.—Ed.

Petroleum Refining

Phosphorous Pentoxide as a Refining Agent for Gasoline.—Boris W. Malishev, in IND. ENG. CHEM., vol. 28 (1936), No. 2, pp. 190–193.

Following up previous work, the author here describes two processes for refining gasoline by means of phosphorous pentoxide. One of these methods consists in treating gasoline with dispersions of phosphorous pentoxide in heavy viscous mineral oils; the other consists in treating gasoline with phosphorous pentoxide deposited on porous solid material.

So far as is now known, the chemistry of the process is essentially an alkylation or condensation. The objectionable chain and cyclic olefines and part of the sulfur compounds are thus removed. In these reactions the phosphoric acid obviously acts as a catalyst.

On a semi-commercial scale the first process is carried out as follows: a bath of heavy mineral oil, which may be an unrefined lubricating oil, is mixed with one or two percent of phosphorous pentoxide which is held in suspension by a small amount of lampblack, with a little cresol as a peptizing agent. The oil bath is heated to between 250 deg. and 285 deg. C., and the gasoline to be treated is vaporized and injected into the oil, which is kept stirred. The gasoline vapors thus refined are dephlegmated, condensed, soda washed and doctor-treated. The process is continuous; the phosphorous pentoxide settles out con-

tinuously and is drawn off to prevent its coagulation, fresh pentoxide being added as make-up. The make-up required in continuous operation is between 0.1 and 0.25 percent of the weight of the injected gasoline. The properties of the treated gasoline are satisfactory; the octane number is raised 2 to 12 points and the bromine number is considerably reduced. A vapor-phase cracked distillate which was high in unsaturated hydrocarbons and could not be refined with sulphuric acid on account of heavy losses and depreciation of its antiknock value, was readily refined with phosphorous pentoxide suspensions.

The other method consists in depositing the phosphorous pentoxide on a porous, solid material, preferably coke, packed into a tower. The gasoline to be refined is pumped under pressures of 200 to 250 lb. per square inch through a heater, where its temperature is raised to 250–300 deg. C., after which it passes continuously into the tower.

At present the market price of phosphorous pentoxide is about $400 per ton. This high price is due to the fact that the demand is small, so there is no special incentive to manufacture it. But there is little doubt that if there were a larger demand the price could be greatly reduced. Even at $400 a ton, the cost of refining gasoline with this chemical should not—according to the author's figure—exceed 10 cents per bbl., including general overhead.

Sulphur Dioxide and Sulphuric Acid from Refinery Acid Sludge.—B. A. Stagner, in REFINER, vol. 15 (1936), No. 2, pp. 55–59.

In a process developed by the Chemical Construction Company, sulphur dioxide is expelled from the acid sludge obtained in refining petroleum products with sulphuric acid; the gaseous sulphur dioxide so obtained is then converted into fresh sulphuric acid by passing it with air over a suitable catalyst.

In an apparatus for the commercial execution of the process, the acid sludge is fed continuously into a rotating kiln and heated to about 540 deg. F. (282 deg. C.) in direct contact either with hot combustion gases from a separate furnace or with coke derived from the acid sludge, the coke having been ignited in a separate kiln and returned to the acid sludge kiln. Direct heating with coke is preferable because a rich sulphur dioxide gas is obtained that can be more easily purified than when the acid sludge is completely burned with air. About 95 percent of the total sulphur is recovered.

Separation of Solvents and Water in Refining Lubricating Oils.—Eugene R. Smoley and Wheaton W. Kraft, in TRANS. AM. INST. CHEM. ENG., vol. 31, No. 4; see also REFINER, vol. 15 (1936), No. 1, pp. 33–37.

There has been rapid development in processes employing solvents for the production of high quality lubricating oils from crude petroleum. These processes include solvent refining and solvent dewaxing. The solvents used commercially include acetone, aniline, benzol, chlorex ($\beta\beta'$ dichloro diethyl ether), cresylic acid, carbon tetrachloride, ethylene dichloride, furfural, methyl-ethyl ketone, nitrobenzene, phenol, propane, liquid sulphur dioxide and toluol. The characteristics of these solvents have been analyzed, and their effect on the choice of the process to be employed for solvent-water separation in solvent refining and dewaxing plants has been indicated. (Bibliography of solvent properties has been prepared.) Included in this paper are flow sheets of typical solvent refining and solvent dewaxing processes. The importance of separating solvent and water in these plants has been indicated. The various methods for separating water and solvent have been discussed and a number of flow sheets illustrating these methods are included. In general, fractional distillation appears to be the most suitable method because of its adaptability to solvent recovery systems and the familiarity of the refiner with this type of equipment. It is necessary to study each problem and then decide which process is most suitable.

Comparative Cost of Operating Shell and Pipe Stills.—W. L. Nelson, in REFINER, vol. 15 (1936), No. 1, pp. 7–10.

Probably more than half of the refineries operating in 1935 are using shell stills to process a part of their crude, but it is estimated that only about 33 percent of all petroleum distillation is carried out in shell stills; much of this percentage consists of the redistillation of pressure distillate, naphtha distillate, pressed distillate and bright-stock solution.

Perhaps the most powerful influence for the continued use of shell stills is the lack of funds. This is a difficult position for a refiner to be in, as he must compete with refiners having modernized plants. However, the author gives a cost analysis (under present market conditions) indicating that the cost of a well-kept shell still battery is not prohibitive, although distinctly more expensive than in the case of a pipe still. The figures are given in the accompanying table.

Summary of Pipe Still and Shell Still Costs

	Cents per Barrel of Crude Oil		
	Pipe Still	Shell Still I	Shell Still II
Inadequate fractionation	0.0	0.7	1.7
Steam	0.6	1.47	1.9
Fuel	0.88	1.2	1.47
Still operation	0.72	1.08	1.3
Repairs maintenance	0.50	1.56	2.4
Power	0.03	0.04	0.03
Depreciation obsolescence	0.82	0.71	1.55
	3.55	6.76	10.35
Loss due to shell still operation:			
Cents per barrel	....	3.21	7.80
Dollars per year	....	$35,100	$85,300

These figures are for the distillation equipment alone, although it may be assumed that refiners operating shell stills are also operating other equipment that is obsolete. The author observes that even though a refiner might now make financial ends meet with a shell battery, it will be well to discard it before the next business depression, because new pipe still competition is appearing each year.

Petroleum Chemistry

Action of Sulphocyanogen on Unsaturated Hydrocarbons.—A. Krassilchik, in ANN. OFFICE COMBUST. LIQ., vol. 10 (1935), No. 5, pp. 923–987.

As the result of experiments with solutions of a large number of unsaturated hydrocarbons in acetic acid, it is reported that the indices of unsaturation are more accurately determined by this method than with the bromine method, because the sulphocyanogen is merely additive and gives rise to no substitution reactions. Hence this use of sulphocyanogen may form the basis of a useful analytical method.

The addition reaction proceeds smoothly, and its velocity constant is easily calculated. All normal olefines have the same constant. The time of reaction between sulphocyanogen depends a good deal on the chemical configuration of the molecule; this affords a means of determining the position of the double bond and the purity of mixtures of unsaturates.

Defects of Gasoline-Treating Methods.—Charles Wirth, 3rd, and Geo. B. Murphy, in OIL AND GAS JOUR., vol. 34 (1936), No. 38, pp. 28–29; 32.

The authors review the present status of gasoline-treating reagents and methods. In the first place, the object of treating gasolines is to remove foul odors, to improve color, and to obtain the greatest possible stability as regards gumming.

Most of the objectionable odor of petroleum is contributed by hydrogen sulfid and mercaptans or thio-alcohols. The hydrogen sulfid may be removed by a caustic soda treatment, and the mercaptans may be converted by the common lead plumbite process into the less objectionable disulfids.

However, in thus dealing with the question of odor, the treatment leaves the gasoline with many undesirable properties. The presence of the disulfids (into which the mercaptans have been transformed) contributes materially to poor color stability, poor susceptibility to the effect of tetraethyl lead, poor susceptibility to gum inhibitors, and to an actual loss in octane number. In addition, the presence of free sulphur, of which an excess is normally required in order to insure complete conversion of the mercaptides into disulfids, also contributes to poor color stability and is a source of corrosion.

The existence of these defects in the ordinary sweetening process shows a definite need for a more satisfactory method of sweetening. Sodium hypochlorite and calcium hypochlorite have been successfully used on a commercial scale as sweetening reagents; these reagents give very satisfactory results when used with straight run gasolines, but the authors consider them open to objection when applied to cracked gasolines.

In the Brucite or magnesium hydroxide process the gasoline is passed through towers filled with the dry, granular reagents; this is

a convenient method, but it has only one advantage over the plumbite method: less of the naturally-occurring inhibitors in the gasoline is removed; hence the treated gasoline has a better gum stability, but the color stability and the octane number are apt to be deteriorated. Dry slaked lime may be used in the same manner as Brucite, with the same results. The Cannon process, which makes use of a mixture of lead oxide, calcium hydroxide and fullers' earth, is comparable with the Brucite process.

Recently, certain processes using copper salt solutions have been used successfully on a commercial basis; the mechanism of the reaction is essentially the oxidation of the mercaptans to disulfids, with the corresponding disadvantage. However, it is claimed for this process that it retains the naturally occurring inhibitors and avoids the loss of octane number normally encountered in plumbite sweetening.

From this review it can be seen that a completely satisfactory sweetening process is yet to be found.

Solvent Refining of Lubricating Oils with Nitrobenzene: Analytical Methods.—S. S. Kurtz, Jr. et al., in IND. ENG. CHEM., ANALYT. ED., vol. 8 (1936), No. 1, pp. 1–5.

This paper describes the analytical methods which have been worked out in the laboratories of the Atlantic Refining Co., covering the development and equipment for the nitrobenzene process for solvent refining of lubricating oils. These methods are also useful in the control of commercial plants now using the process.

Evaluation of Mineral Waxes.—Siegmund Nitsche, in PETROLEUM, vol. 32 (1936), No. 3, pp. 19–22.

Mineral waxes and the ozokerite and ceresine fabricated therefrom are employed to a considerable extent by the wax using industries, chiefly as "homogenizers" in paraffin mixtures. The functions of the mineral wax in such use is to prevent crystallization of the paraffin. The homogenizing property of a mineral wax is determined by mixing 5, 10, 15 etc. percent of the wax with paraffin, dissolving the mixture in hot ligroin, cooling, exposing the resulting paste to the air in flat dishes, and observing the character of the solidified material.

Petroleum Physics

Nature of the Octane Scale.—E. B. Evans, E. M. Dodds and F. H. Garner, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 21 (1935), No. 146, pp. 1,000–1,012.

The present tendency in connection with aviation fuels is to demand higher octane numbers, and fuels have been supplied and tested experimentally with ratings of 100 octane and over. In view of this tendency, the question of extension of the octane scale beyond 100 becomes of practical importance. To avoid difficulties inherent in the bouncing pin method in connection with the C.F.R. testing engine, a method has been devised by which the occurrence and degree of knocking may be obtained directly from diagrams on a cathode-ray indicator or a special pressure gauge in conjunction with a microphone. The inherent disadvantages of the bouncing pin may thus be avoided, together with the present unsatisfactory methods of obtaining standard knock intensity. The pressure scale also gives a convenient method of extending knock-rating measurements to fuels of higher anti-knock value than iso-octane, and of determining octane numbers in the range 85–100 where difficulties are encountered with the C.F.R. motor method.

The proposed method involves two separate operations: (1) determination of incipient knock either by ear or preferably by using a microphone or temperature plug; in the case of the C.F.R. engines this involves an adjustment of the compression ratio under standard conditions so that a constant, very slight degree of knock is obtained which is regarded as incipient detonation; (2) determination of the pressure by a special pressure gauge fitted to the engine to record peak pressure. This gauge is on the lines of the C.F.R. pressure gauge, but is designed to withstand explosion pressure and has proven very satisfactory. From this data the octane number can be read off from a curve given.

The method here given enables a comparison of octane number scales on different engines to be obtained, so that even if the engine is changed, the octane number scale as obtained for the C.F.R. motor method can be retained as a standard scale of reference.

Ball and Bucket Viscosimeter.—E. S. L. Beale and P. Docksey, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 22 (1936), No. 147, pp. 42–48.

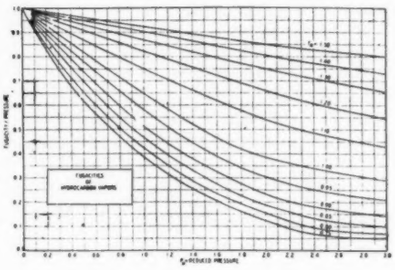
The authors have devised a new form of viscosimeter that will measure the viscosity of liquids over a wide range of viscosities and temperatures, requiring only a small quantity of oil for its operation, and readily adaptable to semi-automatic recording. It can also be applied to the measurement of the consistency of waxy oils and other liquids having solid matter in suspension, which have no true viscosity, but for which a reliable measure of consistency is needed.

The apparatus consists of an adaptation of the well known "falling sphere" viscosimeter, but on the reverse principle. The steel ball is supported mechanically and the surrounding tube, which is closed at the bottom and contains the oil, is allowed to fall under its own weight. In this way the relative motion of the tube (here called the bucket) can readily be observed. At the end of its fall the bucket registers the time consumed, thus freeing the operator from the necessity of watching the instrument in case the time is long. Repeat determinations can be made with great ease, with an accuracy within 0.1 percent over a temperature range of 400 deg. F. to −40 deg. F.

Application of Physical Data to High Pressure Processes.—W. K. Lewis, in IND. ENG. CHEM., vol. 28 (1936), No. 2, pp. 257–262.

For the design and control of operations involving the reactions of hydrocarbons under cracking conditions, it is necessary to know their properties under high pressures. It is under such conditions that the so-called perfect gas laws, which may be valid at low pressures, break down and leave the practical man dependent on empiricism. In this paper the author presents six curves and the outline of a theoretical method of computation, whereby pressure-volume-temperature relations of higher hydrocarbons (three or more carbon atoms) may be calculated; such calculations require no knowledge of the critical volume, only the critical pressure and critical temperature of the substance. These same hydrocarbon curves can be used successfully to approximate the properties of other compounds, even though of widely different types.

One of these graphs, illustrated in the accompanying drawing, makes use of the so-



called fugacity (computed from the known pressure-volume-temperature relations of the vapors) in relation to pressure referred to a reduced equation of state. The method of computing the curves of this figure is believed to be the most dependable generalized method of computing hydrocarbon vapor-liquid equilibria, particularly as applied to pressure conditions that are high in comparison with the saturation pressure of the component, whose distribution between liquid and phase is the subject of interest.

Relation Between Redwood Seconds and Kinematic Viscosities.—Guy Barr, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 22 (1936), No. 147, pp. 1–10.

This paper gives an account of a research undertaken with the object of revising the formula for converting Redwood seconds to kinematic viscosities, which was first prepared in 1913. The program of work was arranged by the Viscosity Panel of the Institution of Petroleum Technologists, a series of twelve oils of suitable viscosities being used. As the result of this investigation, it was found that the relation cannot be expressed by any single linear formula.

Estimating Reid Vapor Pressure from Distillation Data.—Harold M. Trimble and Jules O. Richardson, in REFINER, vol. 14 (1936), No. 12, pp. 562–564.

The estimation of the vapor pressure of a gasoline is useful only when distillation data are available, and the Reid vapor pressure is needed. It is also desirable to have a means of checking the Reid vapor pressure and the A.S.T.M. distillation determinations. In the present report a method is developed which gives reasonably accurate results within a short time.

The basic data required for this determination are the five percent, the 20 percent evaporated temperatures and the Reid vapor pressures obtained from 800 selected samples of gasolines. From this data a nomograph is constructed from the five percent and the 20 percent distilled temperatures, with a scale of

Reid vapor pressures lying in between. If the two distillation data are known the nomograph shows at once the approximate Reid vapor pressure; in 99 percent of the cases the average deviation of the result will not exceed 1.0 lb. The degree of accuracy will depend on the accuracy of the A.S.T.M. distillations (Meth. D 86-30).

P.-V.-T. Relations of Gaseous Mixtures.—E. R. Gilliland, in IND. ENG. CHEM., vol. 28 (1936), No. 2, pp. 212–215.

In this paper the author shows how the slope of the isometric of a mixture can be calculated by the molal average of the slopes of the isometrics of the constituent gases, all measured at the same molal concentration. This rule, together with a given method for estimating the internal pressure, furnishes a means of predicting the pressure-volume-temperature properties of the mixture. For three gaseous mixtures considered, the agreement with the experimental data is better than either Amagat's or Dalton's laws, and is probably within the experimental error of the data.

Uses of Petroleum

Effect of Crude Source on Quality of Diesel Fuel.—Wm. H. Hubner and George B. Murphy, in NAT'L PETR. NEWS, vol. 28 (1936), Nos. 4 and 5.

A survey was conducted by the authors to determine the exact fuel requirements of Diesel engines as recommended by the manufacturers of such engines and the quality of Diesel fuel available from the different oil fields of the United States. Of 37 manufacturers of Diesel engines who submitted information it appears that the majority regard ignition quality, cleanliness, and viscosity as the most important qualities, in the order named, of a satisfactory Diesel fuel. There is considerable divergency of opinion among Diesel manufacturers regarding specification limits and the relative importance of various items, which indicates the need for cooperative testing between engine builders and oil refiners.

In the second part of their work, the authors purchased straight run and cracked Diesel fuels from refineries representing nine different oil fields in the United States, and subjected them to thorough laboratory inspection and engine tests; the engine tests were made both by the C.C.R. (critical compression ratio) method and the "ignition lag" method of Boerlage and Broeze. In these tests they used a modified C.F.R. engine.

From the results it appears that irrespective of the source of the crude oil, the cetane ratings of the straight run and cracked fuels, as well as of their 50–50 blends, are higher by the C.C.R. method than by the delay method, though both are in the same order. On the other hand, the delay method rates the doped fuels (ethyl nitrate added) higher than the C.C.R. method; hence when a cetane rating is made of a doped fuel it is necessary to specify the method. With the exception of doped fuels and certain alpha-methyl napthalene blends, there is a general relationship between the cetane number (by both methods) and other ignition-quality factors. The blended octane number appears to give the closest correlation with cetane ratings; in other words the fuel that knocks the hardest in a gasoline engine rates the highest in the Diesel engine. All four of the ignition-quality factors included in the "universal oil products characterization factor" also correlate well with cetane number.

The conclusion from this work is that the various oil fields in the United States will be able to meet, without difficulty, the requirements of commercial Diesel engines whether of the high, medium or low speed type, not only from the standpoint of ignition quality, but also from the standpoint of the specifications relating to physical properties.

Alteration of Lubricating Oil in Use and Its Regeneration.—H. Kamptner, in PETROLEUM, vol. 32 (1936), No. 6, pp. 1–10.

The question of the changes undergone by a lubricating oil in use has been extensively investigated by numerous authorities, and the present article contains a further contribution to the subject. Certain facts now seem to be well established.

The acid number of the oil always increases during use. The flash point of the oil is always quickly lowered after every change of oil in the crank case, due to dilution with gasoline, but the flash point seldom falls below 158 deg. C. The viscosity of the oil always increases in use, but the increase is not great; this increase in viscosity is apparently due to the formation of semi-solid substances, such as gums, etc.; when these have been removed by filtration with an active carbon the viscosity is found to be little changed. The ash content of the oil increases perceptibly due to abrasion and absorption of dust. Filtration (by suction) decreases the acidity, either because the acids are volatile and are removed by the partial vacuum, or because fixed acids are removed from the oil by the filter.

A complete regeneration of used lubricating oil may be effected by heating the oil to 130 deg. C. and distilling with steam to remove gasoline. The oil is then cooled to about 60 deg. C. and treated with four percent of its weight of concentrated sulphuric acid. After separating the acid sludge the oil is treated with two percent of its weight of magnesium oxide and five percent of clay, and filtered at a high temperature.

Most of the oil used in crank cases is lost by oxidation or splashing, and there are considerable losses in the process of regeneration. These losses amount to about 80 percent of the original charge.

Asphalt and Tar

Adhesion of Asphalt Emulsions to Sand and Mineral Aggregates.—J. Jacksel, in ASPHALT UNDTEER, vol. 36 (1936), No. 7, pp. 101–104.

As is well known, the asphalt in asphalt emulsions adheres readily to rock aggregates composed of limestone, granite and trap rock, and in general, to mineral substances that have more or less of a basic character. After standing for some time in contact with such aggregates, the asphalt is found to adhere so strongly that it cannot be re-emulsified by shaking with either cold or hot water.

On the other hand an asphalt emulsion does not adhere readily to quartz sand until the emulsion has been more or less dewatered. Good adhesion to sand is obtained if the sand has been slightly coated with hydrate of lime or portland cement. The layer of such basic material on the sand grains provides a "polar surface" on which the molecules of the naturally acid asphalt can form an adhering "double layer", which prevents re-emulsification when the mixture comes into contact with water before hardening.

The Viscosity of Road Tars.—J. G. Mitchell and A. R. Lee, in JOUR. SOC. CHEM. IND., vol. 64 (1935), No. 50, pp. 407–411.

The variation of the viscosity of road tars with the temperature can be represented by an equation.

$$vT^n = a,$$

in which v is the viscosity, T the temperature, and n and a are constants. The logarithmic form of this equation is

$$\log v + n.\log T = \log a = A$$

By using this equation and plotting log. viscosity against log. temperature a straight line is obtained. It is therefore sufficient to make only two viscosity determinations (three if great accuracy is desired) to obtain the entire viscosity temperature relation. The constant n is called the logarithmic coefficient of the temperature. There is a first order relation between n and the log. of viscosity of tar distillation residues having viscosities (at 25 deg. C.) between 10^2 and 10^6. A relatively simple relation has been found to subsist between the variation of the viscosity and the loss of oil on distillation; this relation is of some use in the study of tars.

Petroleum Substitutes

City-Gas Filling Stations for Trucks.—H. Kahno, in OEL UND KOHLE, vol. 12 (1936), No. 7, pp. 141–146.

One of the aims of the German government is the complete motorization of road traffic. The chief obstacle to the complete fulfillment of this plan is the scarcity of petroleum products in Germany, or rather the scarcity of foreign exchange with which to finance petroleum imports. To get around this difficulty every possible domestic motor fuel is to be put to use. One such domestic fuel that is available in large quantities is ordinary city-gas, made from coal. In order to make this gas of any use in an internal combustion motor it has to be highly compressed, and the difficulty heretofore has been to provide light-weight gas flasks or cylinders that would hold enough fuel for a long trip. This difficulty has been partly removed by the fabrication of cylinders made of a new steel alloy which can stand a pressure of 200 atmospheres and be light enough to attach to a truck. On the basis of

this item of progress city-gas filling stations for trucks have been established in Hannover and Berlin, and numerous others are under construction in various parts of the country. At each of these stations city-gas is taken from the mains and compressed into cylinders holding 353 cu. ft., which is equivalent to about 1.4 gallons of gasoline. Seven of such cylinders, each weighing about 120 lbs., are required for a five-ton truck that is expected to do 66 miles a day in city traffic.

Existing trucks have to be slightly modified to use this fuel. The establishment of city-gas filling stations is expensive, as each has to have a powerful 5-stage compressor. However, in view of the exchange situation in Germany and the high cost of gasoline, the proposition has been deemed economical even where one station serves no more than 10 trucks.

ALCOHOL AND KEROSENE AS TRACTOR FUELS.—A. B. Calamboy and N. L. Cuevas, in PHILIPPINE AGRICULTURIST, vol. 24 (1935), No. 7, pp. 549–561.

Comparative field trials were made with alcohol and kerosene as fuels for a Fordson tractor. The results are given as follows:

The fuel consumption of kerosene was 14.35 gallons per hectare; of alcohol, 16.45 gallons per hectare. By volume it took 1.15 times as much alcohol as kerosene to plow the same area. It took 7.21 hours to plow a hectare when kerosene was used as fuel and 7.84 hours when alcohol was used. This means that there is a saving of 0.63 hour a hectare by using kerosene as fuel. The cost of field operation when kerosene was used as fuel was 8.64 pesos, and 7.37 pesos when alcohol was used. Thus, for fuel in plowing one hectare of land, alcohol was 1.27 pesos cheaper than kerosene.

To operate the tractor with alcohol at the same fuel cost as with kerosene, the price of alcohol should be 0.87 times the price of kerosene. The present price of alcohol is 0.66 times the price of kerosene. The tractor can not be started with kerosene but can with alcohol. The engine starts more readily on alcohol in hot weather than in cold. At the heavier loads alcohol fuel gave a better performance than kerosene fuel.

Note.—As alcohol is cheaply produced from excess cane in many parts of the tropics such developments may have some bearing on the kerosene trade.—Ed.

RESULTS OF GERMAN TESTS WITH DOMESTIC MOTOR FUELS.—Anon., in MOTORENBETRIEB U. MASCHINEN-SCHMIERUNG, vol. 9 (1936), No. 2, pp. 2–4.

Extensive road tests with various types of vehicles employing various kinds of fuels were conducted under supervision of the German Minister of Communications, with the object of obtaining an impartial judgment as to the merits of motor fuels locally obtainable in Germany. The test fleet was composed of 46 motor trucks; 38 of these were equipped with gas producer and explosion engine, including 20 operating on wood, one on low temperature brown coal coke, 10 with wood charcoal, two with anthracite, two with peat coke, one with brown coal briquettes, and two with low temperature stone coal coke. Of the remaining eight trucks, three were operated by Diesel motors using a Diesel fuel made from brown coal, one with explosion motor using rich gas (Ruhr gas oil and Deurag gas), one with explosion motor and methanol (methyl alcohol), and two trucks with steam engines stoked with stone coal.

The trucks, all carrying full loads, were driven over a course of 16,000 kilometers (about 10,000 miles) that included all kinds of grades and traffic conditions. Each truck was equipped with speed recorders and was accompanied by an engineer observer who took notes on the behavior of the engine under different traveling conditions. Fuel consumption and service costs were carefully recorded for various characters of roads and different speeds of operation. From the results it appears that the lowest fuel cost (based on current German price levels per ton/kilometer) is to be credited to brown coal coke, stone coal coke and anthracite (0.4 to 0.5 RM). In the case of liquid gas the cost ranged between 3.3 and 3.5 RM; brown coal Diesel oil, 1.1 RM; wood, 0.7 to 1.3 RM; wood charcoal, 1.0 to 1.7 RM. However, travel speed with liquid fuels was much greater than with producer gas, and the latter required a somewhat more expensive servicing. The motors operating on generator gas required more time for starting, whether cold or hot. As regards cylinder wear, this was no greater in the case of wood and wood charcoal than with Diesel motors, which testifies to the efficiency of the gas filtering systems. The character of the ash of the solid fuel is of importance; if it is of alkaline nature it is likely to attack the lining of the furnace and cause trouble. The different fuels had quite different effects on the cylinder oil. Wood fuel produces tar which has a tendency to increase the acidity, the viscosity and the asphalt content; wood charcoal is very much better in this respect; the least oil contamination was observed with liquid gas and methanol.

Petroleum Reserves

PETROLEUM RESERVES OF ROUMANIA.—G. Macovei, in MON. PETROLE ROUMAIN, vol. 37 (1936), No. 3, pp. 183–187.

So far as is definitely known, the oil-bearing terrains of Roumania lie exclusively along the eastern Carpathians, in the districts of Valcea and Gorj, in the Maramures and in certain localities of the Transylvania basin; these are the only proven reserves.

Since the beginning of operations the maximum extension of proven oil property has never exceeded 14,330 hectares. Of these 6,800 hectares have been completely exhausted, leaving 7,530 hectares, of which not all are of equal value; some are nearly exhausted, others are being invaded by water, so that the first-class oil territory may be considered reduced to about 3,100 hectares. In addition to the known fields, there are 6,100 hectares that are probably oil-bearing. If half of these expectations are realized, the grand total of about 6,100 hectares (about 15,000 acres) represents the present extent of oil land on which the country can safely count. Since experience has indicated that the average yield does not exceed 10,000 tons per hectare, it would appear that the assured oil reserve of Roumania cannot be estimated at more than about 61,000,000 tons. If the annual rate of production does not exceed the 1934 rate (which is not considered probable) this reserve will hardly last for more than 7½ years.

The above refers to known and probable reserves. There are certain districts in which petroleum might be discovered, particularly in Muntenie and in Moldavia. The possible oil territory in Muntenie can hardly exceed 9,100 hectares, or perhaps 11,300 hectares, which might last for 15 years. In Moldavia the likely oil territory can be evaluated at hardly more than 20,000 hectares. This being the case, and past experience having shown that an annual production of 8,500,000 tons requires the complete exhaustion of 850 hectares (2,000 acres) of first-class oil land, in order to maintain intact the present known reserve of 60,000,000 tons it will be necessary to thoroughly explore 6,000 hectares annually in the Muntenie district or an area five times as great in Moldavia. For these reasons the government is urged to organize more extensive wildcatting operations under the most competent direction.

NEW OIL RESERVES NEEDED.—V. R. Garfias and Raymond V. Whetsel, before Am. Inst. Min. Met. Eng., February 1936.

The estimated world consumption of petroleum products during the next ten years will average around 1,700,000,000 bbl. per year. The world reserve of crude oil to satisfy this consumption will have to be around 15,000,000,000 bbl. The authors place the proven oil reserves at slightly less than 22,000,000,000 bbl.; this represents only oil in sight and recoverable by methods now in use at cost figures permitting economic operation; possible or probable reserves are not included. They give the known crude oil reserves of leading nations of the earth, as of January 1, 1936, as follows:

United States	10,575,000,000 bbl.
Russia	2,830,000,000
Iraq	2,475,000,000
Iran	2,150,000,000
Venezuela	1,350,000,000
Roumania	633,000,000
Dutch East Indies	450,000,000
Mexico	420,000,000
Colombia	275,000,000
Peru	138,000,000
British India	111,000,000
Argentina	92,000,000
Trinidad	91,000,000
Other countries	375,000,000
Total	21,965,000,000 bbl.

The conclusion is that while visible supplies are adequate for the present, the discovery of new fields is essential if a shortage is to be averted, particularly as regards the United States.

U. S. CRUDE RESERVES ENLARGED DURING 1935.—W. L. Baker, in OIL WEEKLY, vol. 80 (1936), No. 9, pp. 19–22.

The United States petroleum industry started the year 1936 with a considerably greater volume of crude oil reserves than it had 12 months previous. More drilling activity during 1935, particularly of the exploratory or wildcatting type, resulted in finding 175 new fields, extensions to old fields and new producing horizons in already productive pools. These new strikes are estimated to have discovered 1,810,000,000 bbl. of future and heretofore unknown reserves, while the nation was producing 995,000,000 bbl. of oil. Therefore, the estimated proved underground supply of crude oil in known United States

fields that is extractable by ordinary producing methods in current use was advanced from 12,177,000,000 bbl. on January 1, 1935, to 12,992,000,000 bbl. on January 1, 1936, an increase of 815,000,000 bbl.

Five districts—Texas, Oklahoma, New Mexico, Louisiana and the Rocky Mountains contributed this increase, while four have been registering declines, the lagging districts are California, Kansas, Michigan, and unclassified.

Of the 21,132 wells completed during the year, 11,906 are in Texas, where 900,000,000 bbl. of new reserves were opened up, from which is to be subtracted 390,000,000 bbl. of annual production, leaving a net contribution of 510,000,000 bbl. by this state to the visible reserves; this accounts for about two-thirds of the increase.

The addition of 815,000,000 bbl. to the reserves has little significance from the immediate market standpoint, because there is no known way to make an oil well yield all its oil at once; it will be produced gradually. Furthermore, it is expected that consumption in 1936 will reach an all-time peak, and it is still necessary that oil companies continue the search for additional underground reserves.

General

USE OF HYFLO-SUPERCEL IN THE MINERAL OIL INDUSTRY.—S. Both, in PETROLEUM, vol. 32 (1936), No. 7, pp. 5–9.

Hyflo-supercel is the trade name of a diatomaceous earth prepared for use as a filter aid. In the mineral oil industry it finds use in filtering acid treated oils to remove suspended tarry matters that do not settle out readily with the acid sludge; it is especially applicable to cases where the acid slime is very finely divided and of approximately the same specific gravity as the oil, so that separation by high speed centrifugals would be impractical. Filtration with hyflo often reduces the acid number of a sour stock 50 to 90 percent. Although the diatomaceous earth does not have the decolorizing properties of a fullers' earth, its effect in removing filtrable colloids is to reduce the necessary quantity of bleaching earth by 20 to 40 percent.

Another application of this filter aid is in de-paraffining; in this use the paraffin-containing oil is mixed with 50 to 75 percent of the weight of paraffin (depending on whether the paraffin is crystalline or amorphous), and the mass is filtered; the filter aid is recovered by remelting the filter cake. The saving in time is said to justify this process.

Filtration through a layer of hyflo-supercel is recommended as a means of breaking refinery emulsions.

ORGANIC INHIBITORS OF CORROSION: ALIPHATIC AMINES.—Charles A. Mann, Byron E. Sauer, and Clifford T. Hultin, in IND. ENG. CHEM., vol. 28 (1936), No. 2, pp. 159–163.

When a solution of an aliphatic amine is brought into contact with a metal surface, such as iron, a layer of the amine is formed on the metal surface through the nitrogen atom of the amine. When an acid is added to the solution, the layer of amine molecules on the iron protects the iron from the action of the acid, which may still act on other decomposable materials in the vicinity. In this sense the amine acts as an "inhibitor". Long straight-chain aliphatic amines and triamines are found to be excellent anti-corrosion inhibitors. The degree of effectiveness of these substances as corrosion inhibitors depends on the stereochemical structure of their molecules, that is to say, on the difficulty they put in the way of the hydrogen ions of the acid in their natural tendency to attack the iron. The longer the hydrocarbon chains and the greater the number of these chains (up to three) attached to the nitrogen atom of the amine, the greater is the inhibitory effectiveness and the less of the inhibitor is required.

Note.—This subject is of considerable importance in the acid treatment of oil wells, where it is highly desirable to keep the acid from attacking the steel casing and other well equipment.—Ed.

PECULIAR ALPINE OIL SHALE.—E. Belani, in OEL UND KOHLE, vol. 12 (1936), No. 1, pp. 12–13.

In the Likaer-Pljesivoca district in Croatia is a peculiar deposit that points to the origin of bitumens and hydrocarbons from animal (fish) sources. In the ancient Cretaceous sea there was a bay protected by a bar in which lived great numbers of a fish: *Gyrodus titanus* Ap. Earth movements trapped this fauna and their decomposition has given rise to a black bituminous mass from which a peculiar bitumen known as "gyrodal" is obtained by careful distillation. This is an insoluble, dark brown, oily liquid of sulphurous-bituminous odor, and has been worked into therapeutic products similar to ichthyol. Another preparation, thioseptol, is highly unsaturated, is lipoid-soluble and to some extent water soluble. It is used in vegetable oil medicinal soap as an emulsifier.

NEW USES FOR SPENT FULLERS' EARTH.—H. L. Kauffman, in NAT'L PETROL. NEWS, vol. 27 (1935), No. 52, pp. 25–28; (1936), No. 1, pp. 21–22.

The disposal of spent fullers' earth and refiners' clay has always been a problem around a refinery, and the author of this paper comes forward with a number of suggestions.

One of the suggestions refers to a discovery by Meade and Nystrom that by using spent granular fullers' earth in place of all or part of the sand used in the preparation of plasterer's mortar, the resulting mortar would dry much more rapidly than when gypsum plaster alone was mixed in; the dried and hardened composition is also lighter in weight and more moisture resistant. It is said that a number of architects in northwestern Pennsylvania and southwestern New York are now specifying spent granular fullers' earth in place of plasterer's sand. The preferred granulation for interior plaster work is 30/60 mesh.

According to the Evans patent (1,755,638) a small amount of spent contact-filtering clay added to a cement mixture makes the resulting cement practically impervious to moisture. Good concrete building blocks are made by compressing 1½ parts sand, 1½ parts spent fullers' earth, and one part by volume of cement. Finely ground burned fullers' earth (free from oily or organic matter) is used in conjunction with alum in treating turbid water. According to the author's experiments, properly conditioned and finely ground spent fullers' earth is superior to ground limestone and similar materials as a constituent of asphaltic compositions. Some development work by the Tide Water Oil Co. contemplates the use of spent fullers' earth in the manufacture of black pigments for paints. Another process for making black pigments is to distill West Virginia coal in the presence of fullers' earth. Spent granular fullers' earth has approximately half the insulating value of cork and diatomaceous earth.

HYDROGENATION OF BITUMINOUS SCHISTS.—J. Borlot, in COMPTES. RENDUS ACAD. SCI., France, vol. 221 (1935), No. 23, pp. 1137–1138.

When oil schists are pyrogenated in the presence of hydrogen or a mixture of carbon dioxide and hydrogen with at least 60 percent of the latter, the quality of the distillate is considerably improved in comparison with that obtained by simple pyrogenation. The distillate boils below 360 deg. C. and on redistillation leaves a very small residue of tar. It is also found that the greater part of the sulphur is eliminated as hydrogen sulphide, which has very little corrosive effect on the steel tubing in which the hydrogenation-pyrogenation is effected.

OIL AND MODERN TRANSPORT.—Sir John Cadman, in OIL NEWS, vol. 39 (1936), No. 1207, pp. 50–56.

It is often said that oil is an enemy of coal; the author subjects this assertion to a critical analysis. As regards British railways, these consumed 13,200,000 tons of coal in 1913 and 12,700,000 tons in 1934; it is thus evident that coal is practically holding its own in that branch of transportation. On the other hand it is a fact that much transportation is now being effected by motor vehicles operating on petroleum products; it is also a fact that the manufacture of the steel, glass, and other materials of which these vehicles have been built, and the construction of roads over which they travel, have required the use of much coal. In this connection the author quotes a reputable (unnamed) scientist who has estimated that every ton of motor spirit consumed in Great Britain probably has caused the consumption of a ton of coal. If this is correct, the 4,200,000 tons of petroleum consumed in Great Britain in 1934 created a demand for 4,200,000 tons of coal. If it be admitted that the 2,250,000 tons of fuel oil consumed in that year displaced an equal quantity of coal, the net gain to the coal industry by reason of the oil business is still 1,950,000 tons.

It is an undeniable fact that the mining of coal has fallen off, but this is undoubtedly due rather to increased efficiency in the use of coal than to direct displacement by oil. It is also true that oil has definitely cut into the use of coal for marine transport, and this apparently represents a permanent loss to the coal interests.

As clinching the argument that increased efficiency in the burning of coal as an industrial and domestic fuel is the reason for decline in coal production, the author cites the fact that between 1913 and 1934 British coal production declined 66,000,000 tons, while total oil imports rose by 6,600,000 tons. In other words, the increase in oil consumption amounted to only a tenth of the fall in the output of coal. It is patently impossible for 6,600,000 tons of oil to do the work formerly done by 66,000,000 tons of coal.

SHIPPING

THE big oil groups are plunging steadily into new construction work, and in addition a large number of Scandinavian orders have recently been placed.

As this is being written the announcement is made of the placing in Denmark of another tanker for Norwegian owners. She is a large vessel of about 14,500 tons deadweight and her contract price will be about £138,000. A similar vessel was ordered by a Norwegian owner and one of 12,500 tons in January of this year, thus adding to the fleet of tramp tankers under construction in Scandinavian yards for Norwegian owners. Tanker ownership seems to have a fatal attraction for the Norwegians and there is no doubt that in the past many of them have profited exceedingly thereby. Two factors stand out above all others in assessing the future of ships now building; (1) the attitude of the oil companies towards tramp ships, and (2) the matter of speed. As regards the former it may be said that the situation is no different now from what it was before the slump, but in those days the big groups were far less inclined to build up to the hilt than they are at the present time. Furthermore, owing to technical improvements which have taken place in tanker construction during the slump period, many of the big groups have set a very hard pace both as regards speed and equipment. The difference between their own ships and those being offered in the open market may be so marked that marine departments may well press for more ambitious building programmes. The owner of the tramp tanker is faced with many problems. He is not building for his own needs but for those of potential customers with widely differing requirements. His design must therefore, to some extent, be a compromise, for his ships must at the shortest possible notice be able to carry crude or refined oil and to load in a wide range of ports.

Another small coastal tanker of 850 tons deadweight has been placed with the Eriksbergs yard in Gothenburg. This will be a further addition to the rapidly growing fleet of motor coaster tankers operating in Swedish waters and is a parallel to the coaster movement taking place in other parts of the world. The situation in the Mediterranean has naturally drawn attention to the state of the Italian tanker fleet. Italy has in the past been a builder for other nations, mainly for the groups operating in Italian territory, rather than for her own requirements and, as was indicated when the subject was last examined in these columns, her contribution to the International Tanker Pool has been a small one. The committee of experts appointed by the League of Nations has made an interesting report on the whole situation showing that on January 17th of this year the Italian tanker fleet amounted to 82 vessels with approximately 356,000 tons. Of the 356,000 gross tons, 254,000 gross tons are recorded as trading on January 17th last. Of the remainder, 16,000 gross tons are reported as being used as depot ships, 42,000 gross tons as lying at Massowah or Mogadiscio, and 36,000 gross tons as laid up or not having moved for two months. The balance of 8,000 gross tons is not reported.

The report proceeds to state that a number of Italian tankers are, because of their age and size, not eminently suitable for ocean-going voyages, but if all vessels under 2,000 gross tons and also all vessels over 30 years of age are omitted a balance of 270,000 gross tons is left. It must be assumed, in the absence of detailed information as to the actual condition of the individual ships, that this tonnage would be used if necessary for trans-Atlantic voyages. The Committee presumes that Italy would, under pressure of a great emergency, make arrangements for increased storage of oil in shore tanks, so as to release further tanker tonnage for the carriage of oil to Italy. If this were done it is possible that the Italian tanker tonnage which could be sent over the Atlantic for oil supplies might even be as high as 320,000 gross tons. It is certainly not possible for the Committee to say that this could not be done if the Italian need were sufficiently great.

Ordinarily, it could be assumed that a speed of 200 or more miles per day would be attained by a fleet of tankers, but having regard to the average age of the Italian fleet, the Committee thought it well to assume that, on the average, the vessels would not do more than 180 miles per day at sea. Allowing reasonable time for loading, unloading, repairs, etc. this would mean that the ships, if running between Italy and the United States Gulf ports, would, on average, make 4.75 instead of a normal five or six voyages per year.

The average cargo-carrying capacity of a tanker is approximately one-third more than her gross tonnage. The Committee is accordingly led to the conclusion that if the Italian supplies of oil had to be drawn from the Gulf and 270,000 gross tons were put into the trans-Atlantic trade the Italian fleet might be expected to carry not less than about 1,750,000 tons of oil from the Gulf to Italy in a year. If, however, as much as 320,000 gross tons were put into the trans-Atlantic trade, and the Committee cannot say that this would be impossible, then the Italian tanker fleet would carry as much as 2,000,000 tons a year. The Committee has not overlooked the fact that about 20,000 gross tons of tankers are required for the carriage of oil (estimated to amount to 25,000 to 30,000 tons per month) from Italy to its colonies, but it seems probable that the tonnage which has been left out of account above would be sufficient for this, even if as much as 320,000 gross tons were put into the trans-Atlantic trade.

Vessels under other flags which might be employed in the carriage of oil to Italy from the Gulf could reasonably be expected to make at least five voyages a year, and the carriage of 1,000,000 tons of oil to Italy in such vessels would mean the employment for a year of tanker tonnage of about 150,000 gross tons (cargo-carrying capacity, 200,000 tons).

In spite of this Italian activity the freight market does not appear to have reacted very constantly, latest advices showing that enquiry from all directions has been rather poor, the greater demand being for dark oil tonnage, Gulf/Italy having absorbed two or three vessels on a basis of 16/–. The Italian situation is not without its blessings, however, for it has directed the attention of naval architects to the woeful lack of oil carrying tonnage of good type possessed by the British Navy, with the result that future programmes may well show the placing of contracts of this type. Even so there seems to be no tendency at the moment to go in for tonnage whose speed equals that of the Japanese ships. It is pointed out that their requirements are rather special since their work is purely in the nature of a civil liner trade between San Pedro and the naval ports in the Inland Sea.

It is unusual in these depressed times to find investors being invited to subscribe for shares in a shipping company. It was announced last week, however, that the Viking Tanker Company, Ltd., which has a share capital of £200,000 in shares of £1 (half of which is in 5½ percent cumulative preference shares), was selling its shares at 21s each. The company is to acquire the motor tankers NORE, of 12,478 tons deadweight, and NORVINN, of 10,476 tons deadweight (both built in England in 1930), the former at £120,000 and the latter at £110,000, the balance between the price paid for the shares and the share capital to be raised by loans. The directors estimate that the net profits will be not less than £40,000 per annum, which, after providing for depreciation at the rate of 9 percent per annum, will leave £19,300 for dividends. It is, however, "the intention of the directors not to recommend a dividend at a higher rate than 7½ percent per annum on the ordinary shares until there has been set aside a total of £115,000 for depreciation or for reserves."

Liaison between the marine engineering industry and the oil industry was well shown early in March by the visit paid by the Institute to the National Oil Refineries at Llandarcy in South Wales, this being the first occasion on which the Institute of Marine Engineers as an official body has made an inspection in this part of the world. At the present time marine engineering men are keeping very close to the oil industry because they realise the benefits which the latter can confer upon them.

A. C. HARDY

CANADA

Imports

DURING the month of January imports of petroleum into Canada reached a total of 61,131,349 gallons, valued at $1,797,879. This compared with 55,639,590 gallons during the previous month, December, valued at $1,648,039. It also represented an increase of nearly 2,000,000 gallons over January of 1935. The origins of imports were as follows:

	Gallons	Dollars
United States	42,563,748	1,276,360
Colombia	3,912,682	112,484
Peru	11,606,891	343,520
Venezuela	3,048,028	65,515

Gasoline imports showed a drop from December to January, the figures being as follows: December 1935, 1,214,898 gallons valued at $109,335; January 1936, 1,041,100 gallons valued at $95,404. The United States was the only source of origin during the month of January.

Developments

AS soon as the weather permits, the Imperial Oil Company and Canadian Western Natural Gas Company are going to commence the most extensive gas and oil drilling in the recent history of Alberta. Permits have been issued for the development of 39,000 acres of potential oil and gas lands.

In an area lying between Turner Valley and Alderside Dome deep tests are to be started early this spring. This is being undertaken by three of the outstanding financial groups of the West, who have amalgamated under the name of Arca Development Company, primarily interested in the development of Alberta's gas and petroleum. Some 42,000 acres have been grouped for the first unitization program which has been done so far. It is estimated that no production will be attained above 7,500 ft., and heavy duty equipment will be used. The company is sound financially.

The Imperial Oil Company, through its subsidiary, Northwest Company, is planning to drill several test wells on the Jumping Pound structure near Calgary, Alberta. It is hoped that they will be able to pick up a crude oil sand, but it is not expected that drilling will continue through to the limestone where a naphtha might be found. This enterprise is in the nature of a wildcat.

A recently formed company, Roxana Petroleums, has secured 6,000 acres on the Kootenay structure, nearly 50 miles west of Calgary, and a well will shortly be started.

A wildcat well drilled on the Del Bonita structure, known as the Terminal, is to be given an acid treatment. It is then expected to become a commercial producer. The Weymarn well at Pincher Creek, another wildcat, is expected to enter upon commercial production shortly.

The Union-Freehold well in Turner Valley is progressing favorably. Naphtha is increasing as the gas pressure gradually blows the water from the hole. During drilling operations, thousands of gallons of water were poured into the porous horizon.

It is announced that Turner Valley oil deliveries to the Imperial and Bell refineries in Calgary, Alberta, during 1935 were 968,526 bbl. This compares with 1,049,965 bbl. in 1934, and 739,089 bbl. in 1933. December, 1935, deliveries were 87,355 bbl., an increase of nearly 6,000 bbl. over November deliveries.

The Canadian Western Natural Gas, Light, Heat and Power Company has been successful in their plan of gas storage. To the end of December, 1935, a total of 8,000,000,000 cubic ft. of gas has been stored in the Bow Island gas field. This is the first known development of its kind in Canada. Of 27 wells in the depleted field, 18 were sealed, while the remaining ones were reconditioned and made available for receiving and repressuring purposes. Gas pumping was started in the summer of 1930 from the Turner Valley into the depleted field. Since then, 2,500,000,000 cubic ft. have been pumped each year into the Bow Island field. The gas was supplied by Royalite.

Naphtha and oil deliveries to the larger refineries during 1935 were less than in 1934, which amounted to 1,049,965 bbl. They were, however, considerably in excess of 1932 and 1933.

Olga Gas Limited recently secured an oil and gas lease near Tillsonburg, Ontario, and a well has been drilled. This yielded approximately 750,000 cubic ft. open flow per day, and gas is now being delivered at the rate of 300,000 cubic ft. per day to the Dominion Natural Gas Company. A second well is being drilled.

R. C. ROWE

MEXICO

ALTHOUGH word did not reach those outside the company, reports have just been received from Mexico, that oil was discovered in October, 1935, on lands held by Standard Oil Company of California, in the vicinity of Puerto, in Southern Vera Cruz, Mexico. A second well was completed between the latter part of the same month and the end of December. The oil is 30 deg. gravity or better and is found at a depth of about 2,200 ft. The new field is entirely controlled by Standard Oil Company, which has had the land under lease for several years, as other discoveries in the same general vicinity were made earlier by the Mexican Eagle Oil Company, Ltd. a subsidiary of the Royal Dutch-Shell combine, and affiliated with the Canadian Eagle Oil Company, Ltd. It is reported that a pipeline from the Mexican Eagle Oil Company refinery at Minatitland crosses not far from the new wells.

Discovery well is reported to have flowed above 1,000 bbl. per day on short tests. The second well produced over 50 bbl. an hour. With this showing, Standard Oil Company of California have had an engineer from their San Francisco offices on the ground making a survey to determine what shall be done with oil produced from the new field.

This discovery of a second source of crude outside the United States greatly strengthens the position of the California company in world markets. Should it elect to build a refinery in Mexico, similar to that now under construction near its field on Bahrein Island in the Gulf of Persia, it will be in a position to deliver either crude or refined products to all of the principal world markets from sources outside the United States.

Mexico's oil industry affords its employees greater privileges than are demanded by the federal labor laws and pays them higher wages than are received by workers of many other countries, including the United States, asserts the Association of Petroleum Producers in Mexico, to which most international companies belong. Advertisements of the Association in Mexico City daily newspapers state, in part, as follows:

"The petroleum companies are deeply concerned about maintaining, in so far as is within

their means, improved conditions for labor. They are convinced of the necessity that labor be adequately remunerated and that it enjoy as much social security as possible in the vicissitudes of life. The petroleum industry pays higher wages, viewed from the standpoint of the purchasing power of Mexican money, than are paid in many other parts of the world, including the United States, and allows its workers privileges that far exceed those demanded by the federal labor laws and which, in many respects, are greater than those enjoyed by workers in other countries. For example, we mention the following:

"Free attendance for non-professional illnesses, including hospital, nursing, medicines and doctors; payment of half wages to employees laid up with these illnesses, provided the lay-off does not exceed 60 days a year; free services of eye, ear and throat specialists; loans in cases of death that are greater than the law demands; and maintenance of a savings fund to which the companies contribute a sum equal to that deposited by the employees, which is generally five percent of their salaries, and frequently the addition of a fixed sum at the end of each year."

Another Association advertisement, concerning taxes, says in part:

"Revenues the federal, state and municipal governments obtained directly and indirectly from the petroleum industry amounted to 47,000,000 pesos (some $12,000,000, U. S.) in 1934. A just comparison cannot be made, as circumstances are so different, between prevailing petroleum taxes in Mexico and in the United States, but we cite some of those conditions:

"The United States consumes 92 percent of its production and exports but eight percent, while Mexico uses 40 percent of its production and exports 60 percent. The United States collects in the form of a levy on gasoline consumption 75 percent of total imposts derived from the petroleum industry, although the average valuation is 50 percent lower than in Mexico (4.3 centavos as compared with eight centavos in Mexico). But in Mexico, this impost on the principal product of the petroleum industry represents only 50 percent of the total tribute.

"The United States forbids by law all taxes on exports; in Mexico the export tax (including that on production) represents 36 percent of the total tributes the state collects.

"If Mexico is to compete advantageously in world markets with petroleum producing and exporting countries whose conditions are similar to its own, must it not arrange a plan of tributes that approximates as much as possible that which the competing countries have established for exports of petroleum?"

It is understood that the object of this publicity is to permit the Mexican public to judge for itself the importance of the petroleum industry to its interests.

Federal supreme court held constitutional the 1933 petroleum lands surface tax law, enacted under extraordinary faculties congress granted the president, in rejecting an appeal by Gabriel Flores from a ministry of finance ruling that he must pay 20,000 pesos (some $5,600) on oil lands he owns near Linares, Nuevo Leon state. Flores contended the law is unconstitutional because it was enacted during a period when congress was not in session. Tribunal found that the national constitution allows congress to permit the president to enact laws that are deemed to be of urgent necessity when congress is not in regular session.

An apparatus for testing the explosive power of various grades of gasoline, in order to classify the commodity for marketing, is being used by ministry of national economy. Ministry has fixed retail prices of gasoline at from 18 to 21.5 centavos the liter, the former price prevailing on the Mexico City market. Range is based upon distances of markets from production centers. Ministry says gasoline can be sold on 18 centavo markets for less than that price only when vended in lots of 1,000 liters or more. Gasoline quality must range from 57 to 62 octane.

A review of petroleum activities in 1935, issued by ministry of national economy reports that:

Oil and by-products exports fell to 22,445,972 bbl. from 25,018,181 bbl. in 1934, the decrease being attributed to world economic conditions general in 1935; domestic oil and by-products consumption last year was 17,700,000 bbl. as compared with 16,265,795 bbl. in 1934; home gasoline use in 1935 is estimated at 352,789,000 liters, compared with 313,120,740 liters in 1934.

Oil refinery production amounted to 35,875,084 bbl. last year and 37,331,137 bbl. in 1934. Decreased production last year is attributed to the fact that the refinery of Huasteca Petroleum, one of the largest in Mexico, was closed for four months by a strike. As Mexico's refineries have increased and improved their equipment, ministry anticipates a larger production this year.

Thirty-three petroleum producing and two natural gas wells were brought in in Mexico last year, ministry of national economy announces. Oil wells had a combined initial daily production of 28,444 bbl. and a total average output of 811 bbl. a day. Nine of these wells are in the Cacalilao zone and eight each are in the Panuco and El Plan fields, all in Vera Cruz state.

Both gas wells are near the United States border; one is in the General Bravo fields and the other is in the Ciudad Camargo region, Tamaulipas state. The latter well, Rancherias No. 3, owned by Ohio Mexico Oil Corp., began production with 40,000,000 cu. ft. daily at 1,989 ft.

President Cardenas' reply to a petition of organized bankers, industrialists and business men urging him to investigate economic conditions in Mexico, has caused a certain uneasiness in Mexican oil circles. The President accused these interests of lack of cooperation in the program of his government. It is opined in oil circles that the chief executive, in his reply rather overlooked the cooperation banking, industrial and business interests are affording him and that his answer both reflects resentment and implies threat.

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Official Figures for Soviet Oil Operations

	Crude Production (bbl.)	Daily Average (bbl.)	Runs to Stills (bbl.)	Drilling (feet)
1936				
January	16,500,000	532,290	14,000,000	513,700
February	15,400,000	531,435	13,600,000	460,000
Total 2 Months 1936	31,900,000	531,665	27,600,000	973,700
Total 2 Months 1935	26,062,300	434,372	21,309,500	582,672
Total 1935	176,688,100	497,713	146,705,100	4,868,465
Total 1934	168,846,000	458,042	145,141,000	4,122,898
Quota 1936	213,500,000	581,178	175,000,000	7,100,000
Quota 1935	212,310,000	581,672	171,500,000	5,214,000
Quota 1934	214,900,000	588,876	161,000,000	4,950,000

Crude conversion: seven bbl. = one ton

DURING the month of February the Soviet oil industry displayed increased activity. Stakhanoff decades of operation were introduced in drilling, production and runs to stills, and figures for operation were increased above the corresponding quotas arising from the regular plan. Although these augmented quotas, or "Stakhanoff quota requirements," were not fulfilled by either Baku or Grozni and Maikop, the Stakhanoff decades have brought

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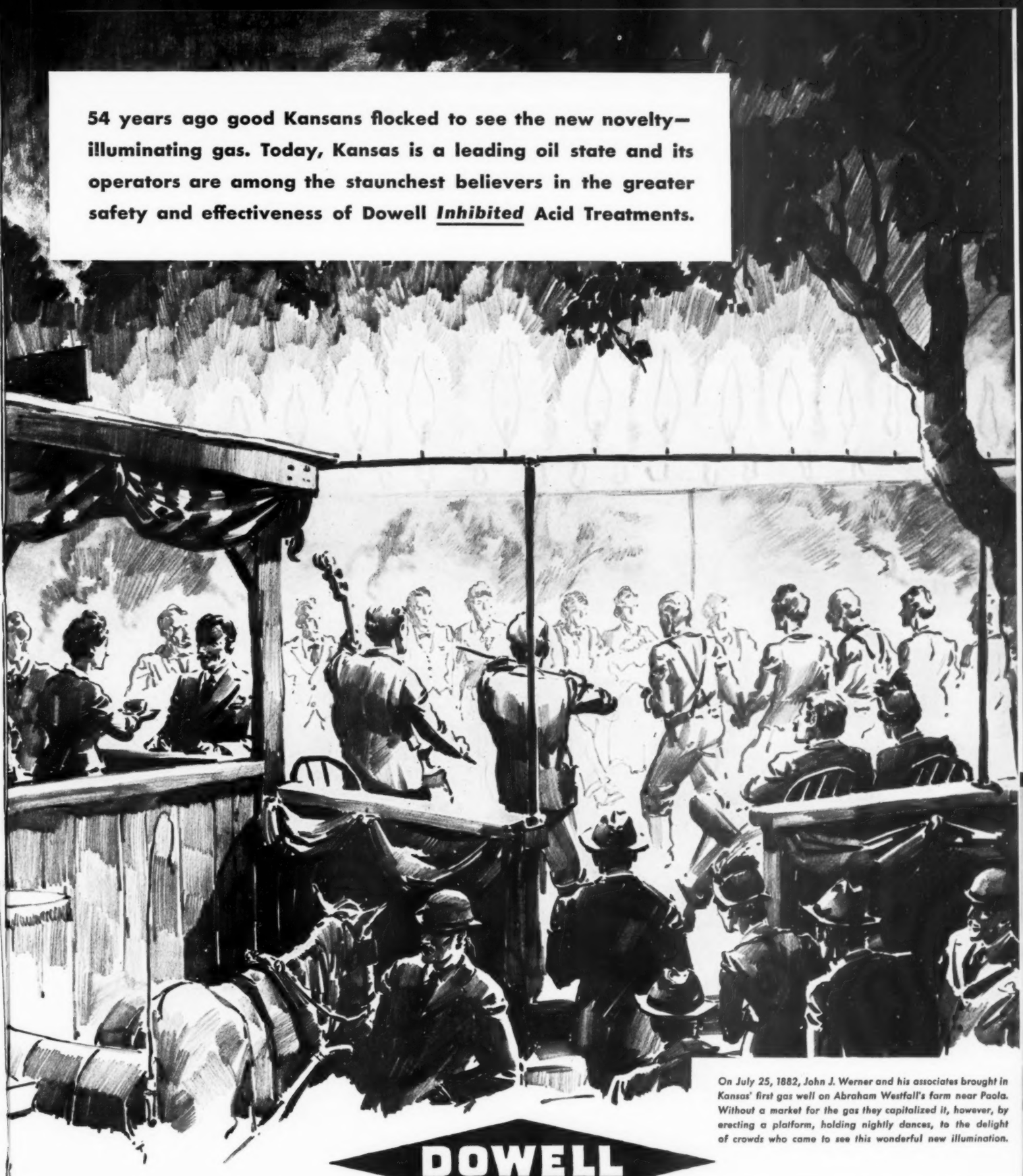

On July 25, 1882, John J. Werner and his associates brought in Kansas' first gas well on Abraham Westfall's farm near Paola. Without a market for the gas they capitalized it, however, by erecting a platform, holding nightly dances, to the delight of crowds who came to see this wonderful new illumination.

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about a general improvement of operations. Baku figures for drilling, production and runs to stills are in excess of the regular quotas for the month. The gains are small, but indicative of the possibilities. During individual days the excess of plan fulfillment for Baku amounted to five to seven percent for crude production, and 25 to 30 percent for drilling, although on other days, under adverse weather conditions, plan fulfillment for drilling ran as low as 62 to 70 percent. The Stakhanoff movement has effected a definite improvement in Baku runs to stills as well as in refinery yield from the crude potential. During the period Baku refineries have yielded 2,650 tons more gasoline, 4,500 tons more kerosene, and 330 tons more bright stocks from the usual quantity of crude input, while the increase of runs to stills over and above plan has amounted 1.7 percent. Definite improvements of operation are also reported from Batum where the refineries have produced, during the first two months of the year, some 12,000 tons of gasoline, 5,000 tons of ligroin, 25,000 tons of kerosene and about 2,000 tons of motor oils above the quota for the period.

Operations at Grozni continue to lag behind plan. Crude production for the month shows plan fulfillment of 92 to 93 percent and drilling 65 to 70 percent. Considerable progress, however, was effected in runs to stills during the Stakhanoff decades of operation when the Grozni refineries ran nine percent ahead of plan and some 7,500 tons of straight run gasoline and ligroin were produced above plan. The Grozni cracking installations have produced approximately 3,500 tons of pressed distillate and about 200 tons of wax over and above quota.

Soviet Prospecting

KOSCHAGIL and South Iskin, two recent additions to the producing properties of Emba, were made ready for commercial production in 1935. These two new oil fields are expected to double or triple the total crude production of Emba which, derived from Makat, Dossor, Baitchunas, etc., has amounted to 230,000 to 250,000 tons per annum for several years past.

Molgabek, the only new discovery at Grozni, started producing in 1934. Crude production of Grozni had declined from 9,000,000 tons in 1931 to 3,500,000 tons in 1934 and further decline was checked only by production of Molgabek. The geological formations of this section are complicated, however, and it is apparent that not until deep drilling is sufficiently mastered will Molgabek enable Grozni to regain its former position.

Ishimbayevo of the Urals is a discovery of about two years ago and its importance to Soviet crude production is growing gradually. Ishimbayevo, at present known as "Bashkirneft", is an extension of the Sterlitamak property discovered in 1928. At the time of its discovery the Soviets believed that Sterlitamak would become the major source of all oil required for internal consumption, thus freeing all oil from the Caucasian fields for export. Sterlitamak did not live up to plans and expectations, but together with Ishimbayevo production, increased gradually with flowing wells coming in frequently. According to plans Bashkirneft has to produce 1,000,000 tons of crude in 1936 and then, perhaps, double the figure in a year or more. However, the best estimates expect Bashkirneft to contribute about 1.5 to 1.6 percent of the total Soviet crude lifted during the next two or three years.

The presence of oil at various other points of the Soviet Union has been acknowledged by Soviet geologists on many occasions, but prospecting operations have been carried on at few places. The limited operations may have been due to lack of appropriations or to lack of adequate equipment. It still remains to be seen whether all the potential oil regions will become successful commercial oil fields.

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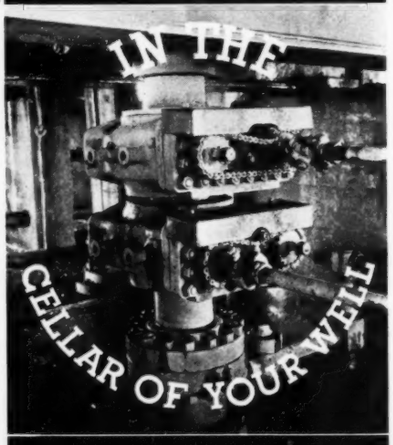

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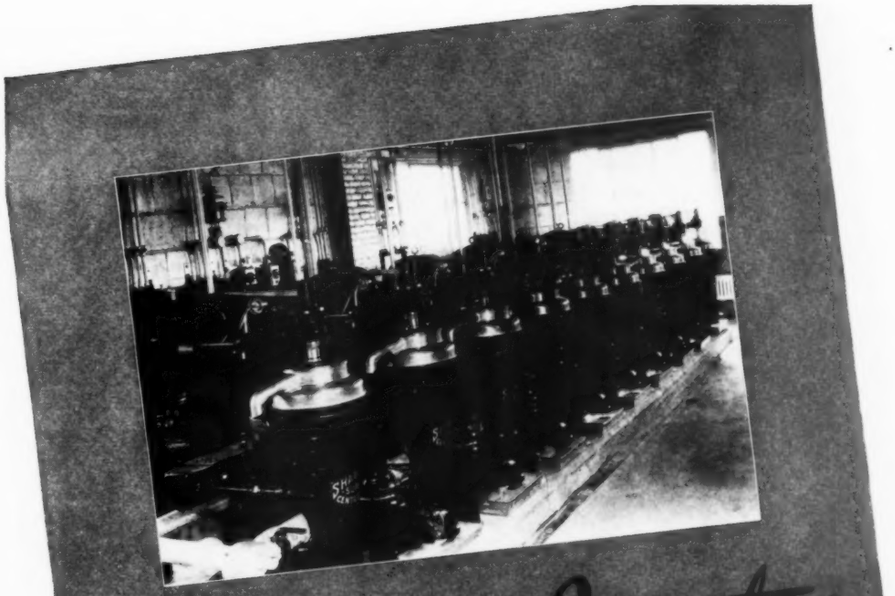

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At present, and perhaps for many years to come, the Caucasian fields (particularly Azerbaidzan) will continue to be the main source of Soviet crude production and, therefore, the mainstay for prospecting. The Azerbaidzan territory, known as Baku oil fields, is rather limited and the proven oil lands have been under operation since the middle of the last century. However, Baku has an immense hinterland and on the Apsheron peninsula alone prospecting in 1933/1934 has brought in new fields of such magnitude as Puta, Lokbatan, Kergez and Artema, where flowing wells of considerable value have enabled Baku to increase its production during recent years. The total area of Azerbaidzan covers about 75,000 sq. miles and the entire area is open for prospecting.

During the first four years after Soviet nationalization of the oil industry very little, if any, prospecting for oil was carried on, even at Baku, as the Soviets had to take stock of what was left in the oil fields after the war and civil strife. Between 1924 and 1932 prospecting was under the supervision of two separate organizations—the Geological Survey (GRU), and Prospecting Drilling Service (URBUR). Dual supervision led to confusion; orders of one organization often overlapped, duplicated and even over-ruled orders of the other organization, and only in 1932 were all prospecting operations placed under one management and modern methods of geological survey introduced.

Over a period of 15 years, between 1920 and 1934, a total of 201 expeditions were sent out to prospect for oil at Azerbaidzan over an area of 45,000 sq. kilometers or about three-fifths of the total territory of Azerbaidzan. These expeditions employed geological and geophysical methods of operation. Carrotage, seismography, aerial photography and all other new methods were not as yet known to Soviet prospecting even at the end of this period.

During 1931 Krelius drilling was introduced in Soviet practice and this method of drilling has gradually replaced the Woislow system in practically all Soviet field operations.

Soviet Drilling Practice

	1931	1932	1933	1934
Distance drilled, (ft.) Woislow system.....	37,255	52,830	49,000	46,035
Distance drilled, (ft.) Krelius system.....	900	20,100	61,900	272,980
Drilling, speed per rig/month, average (Krelius drilling)....	224	384	579	869

From the foregoing it is evident that Apsheron, though operated over half a century, will be the site of the main prospecting operations for several years to come. The commercial value and geological nature of the oil bearing properties in this peninsular territory may be divided into four categories.

(1) The western and northwestern part, where Paleogene formations line up the anticlinal elevation which is familiar to the Caucasus; the commercial value of the oil deposits is still in doubt, however. The productive layer predominates in the southwestern region where Lokbatan, Puta and Kergez are situ-

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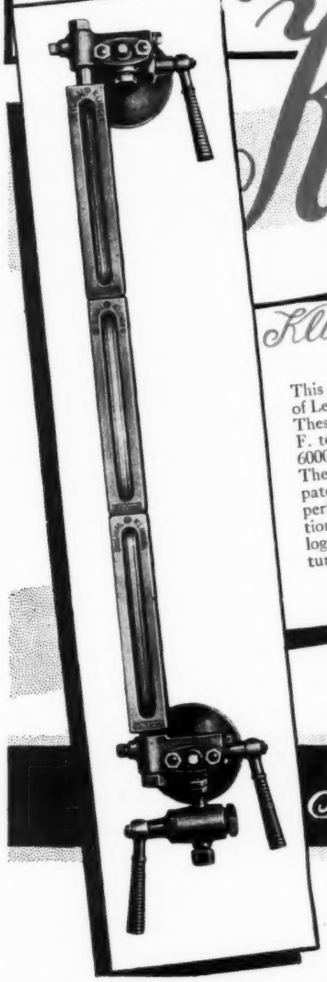

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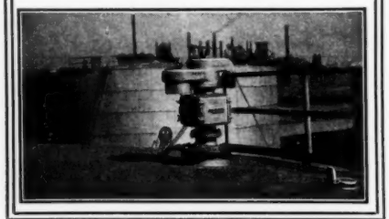

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ated. This region is under close study.

(2) The central part where rich deposits were reported in the southern section. The productive layers are expected to be of high commercial value.

(3) The eastern part. While in the northern direction the productive layer is almost washed away, it is quite open in the central part. In the eastern section the productive layer is underthrust by layers of the Apsheron balcony and overthrust by aged Caspian formations. The Kala property is part of this territory and a number of prospects such as Kurdakhiani, Mardakhiani and Turkiakhani are at present under close study.

(4) The Caspian shore line and sea bottom, where oil and gas exits indicate the presence of oil fields submerged under water, similar to the island of Artema.

In 1932 seven new discoveries were made, which were as follows: Karachukhur, Sulutepe, Kergez, Neftchala, Shongliar, Shabandag and the northern wing of Bingadi. In 1934 five new fields were added, among which Kala, Lokbatan and Artema became important factors of Baku crude production.

Up to 1934 wells drilled to depths of 3,000 to 3,500 ft. were few, but since 1934 such wells have become frequent occurrences and some drilling has extended down to 5,000 ft. The average drilling speed has increased gradually from 176 ft. per outfit per month in 1931 to 245 ft. in 1932, to 253 ft. in 1933, and to 400 ft. in 1934. Recent Soviet drilling statistics show a vast improvement over previous years. This is partially due to the use of selected shock brigades, for whom wells, equipment and operating teams are carefully matched. General routine drilling is still handicapped by lack of adequate equipment and tools, as well as experienced operators for deep drilling.

No figures for cost of drilling are available. However, Soviet statistics published in 1928 show that the average cost of drilling per meter (3.3 ft.) at Baku was 250 Rbl., while at Grozni the figure was 150 Rbl. Cost of drilling includes wages, field dues, fuel, power, transportation and supplies. Wages and transportation costs per meter of drilling are indicated as 18 Rbl. for Baku and 11 Rbl. for Grozni. Drilling costs outside of the Caucasus are more expensive.

Lack of sufficient appropriations for prospecting have delayed progress, and current more generous allotments have come too late to make up for the damage done and time lost. Soviet appropriations for prospecting amount to about 15 percent of the total drilling appropriations. Under Soviet conditions this amount is not sufficient. Soviet oil fields usually operate over a period of two years. Flush production fields are often exhausted within less than a year, though some fields have been operating five years. In Soviet practice stripper wells are overlooked entirely, as the operators have to hunt for flush production and flowing wells in order to live up to plans.

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